# Ancient Perspectives

*Maps and Their Place in Mesopotamia, Egypt, Greece, and Rome*

EDITED BY RICHARD J. A. TALBERT

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*Richard J. A. Talbert*

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# PREFACE

## James R. Akerman

The maps and mapping practices of ancient Egypt, Mesopotamia, Greece, and Rome are at once familiar and unfamiliar ground. The essays collected here discuss several maps that are undisputed monuments of the history of cartography and the subjects of a long trail of scholarship dating back, in some cases, to the Renaissance. Most of the major one-volume surveys of the history of cartography published in the last century treat the ancient geographic territory covered here as the seedbed of Western cartography, and the cartography of the prehistoric ancient Near East, Europe, and Mediterranean forms the focus for roughly half of the first volume of the grand *History of Cartography* edited by Brian Harley and David Woodward, published in 1987. Yet comprehensive examinations of ancient cartography have been few and far between.

The Sixteenth Kenneth Nebenzahl, Jr., Lectures in the History of Cartography, upon which this volume is based, held in November 2007, were organized in part to promote a renewal of scholarly interest in these important foundations of Western cartography. Two decades had passed since the publication of Harley and Woodward's first volume. Much had changed in the interim, both in the history of cartography field and in ancient studies. When I approached the esteemed classicist and scholar of ancient geography and cartography Richard Talbert to organize the lectures, it was with the sense that it was time to revisit the subject in a comprehensive way.

The immediate occasion to do so arose as the Newberry Library, host of the Nebenzahl Lectures since 1966, became engaged in Chicago's Festival of Maps, a citywide public exploration of the history and culture of mapmaking spanning the academic year 2007–8. The Newberry collaborated with the Field Museum in assembling the festival's flagship exhibition, "Maps: Finding Our Place in the World," which included several works discussed in this volume. The Newberry Library contributed two additional exhibitions to the festival: "Mapping Manifest Destiny: Chicago and the American West" and, most notably in this context, "Ptolemy's *Geography* and Renaissance Mapmakers." The latter exhibition focused on the Newberry's renowned collection of editions of Ptolemy, something we had long wanted to do but that cried out for a special and appropriate occasion. The organization of *Ancient Perspectives* as an integral part of the lectures for the Festival of Maps was that ideal opportunity.

Richard Talbert, William Rand Kenan, Jr., Professor of History and Classics at the University of North Carolina at Chapel Hill, was the immediate and obvious choice to organize this sixteenth installment of the Nebenzahl Lectures and to edit this volume. Dr. Talbert was already well known to the cartographic community as the editor of the monumental *Barrington Atlas of the Greek and Roman World* (Princeton, 2000) and as a leading scholar of the historical geography, cartography, and spatiality of the ancient world. Fortunately, he accepted the challenge and soon had assembled an impressive panel of scholars with expertise that ranged widely over the chronological and geographic ground we had selected. I am deeply grateful for the effort and expertise Professor Talbert has poured into this project from beginning to end. I cannot imagine

having a more capable, diligent, or persevering collaborator, or a more collegial one. We are also indebted to his collaborators, both for their provocative original lectures and for their published contributions. They have responded both cheerfully and energetically to our many demands.

*Ancient Perspectives* would not have happened, of course, without the ongoing support of many members of the Newberry Library staff and friends. Four program assistants in the Hermon Dunlap Smith Center for the History of Cartography, Chris Dingwall, Sarah Frank, Laura McDowell, and Will Gosner, helped either to organize the lectures or to bring the volume to press. Ms. Frank, especially, helped me keep my head throughout the planning and operation of the lectures and the Festival of Maps. Another former Smith Center program assistant, Susan Hanf, made our exhibition of editions of Ptolemy's *Geography* happen, under the supervision of Riva Feshbach, then the Newberry's exhibition manager. The Newberry's photoduplication department staff, John Powell and Catherine Gass, provided many of the photos reproduced here and in the special issue of *Mapline* documenting the festival and the Newberry's contributions to it. Bob Karrow, the Newberry's curator of special collections and curator of maps, and Patrick Morris, map cataloger and reference librarian, contributed in ways that defy enumeration. Dr. Karrow was also my cocurator of "Ptolemy's *Geography* and Renaissance Mapmakers." Diane Dillon, assistant director of research and education, shared curatorial responsibilities for the "Maps" exhibition with Dr. Karrow and me. Several members of the Chicago Map Society, notably Art and Janet Holzheimer, helped in the planning and operation of the November 2007 events associated with the Festival of Maps. These included the Nebenzahl Lectures and the annual meeting of the Society for the History of Discoveries, which was organized with the collaboration of the very organized Tom Sander. Roger and Julie Baskes, the Chicago Map Society, and the Philip Lee Phillips Society of the Library of Congress's Geography and Map Division provided additional and generous support to the staging of the lectures. The staff of the University of Chicago Press has been, as always, patient, helpful, and thorough in bringing this latest installment of the Nebenzahl series to press. We thank them for their continuing support.

Above all, the enduring support of Ken and Jossy Nebenzahl has sustained this lecture series for more than four decades. Their vision of an enduring public forum for the presentation of the latest scholarship in the history of cartography has been invaluable to the development both of the field and of the Newberry Library as a place to pursue it. We cannot thank them enough.

# INTRODUCTION

**Richard J. A. Talbert**

Mapmaking in antiquity, as in so many other periods, has attracted more intense interest than ever during the past quarter century. This exciting, fresh engagement is a broad one, embracing the character, scope, and roles of maps in societies everywhere. The ongoing transformation of contemporary mapmaking capacities stemming from the digital revolution has added to the momentum. Stimulus has also come from the heightened value currently attached to interdisciplinary studies: the history of cartography is, after all, nothing if not interdisciplinary. No less beneficial has been scholars' widespread acceptance of the view that the objects to be regarded as "maps" in premodern societies encompass a far wider, more varied range than a strict definition of the term for today would be likely to allow. A pre-modern map need not necessarily be a factual document produced in conformity with certain widely recognized norms; equally, to evaluate it against inflexible modern criteria rather than in relation to the culture in which it was embedded is likely to prove inappropriate, even counterproductive. As is well known, such a looser definition and more sensitive approach were launched by Brian Harley and David Woodward. "Maps," proposes Harley in the introduction to volume 1 (1987) of their ongoing *History of Cartography*, "are graphic representations that facilitate a spatial understanding of things, concepts, conditions, processes, or events in the human world."

This ambitious, pathbreaking first volume of the *History of Cartography* took prehistoric, ancient, and medieval Europe and the Mediterranean as its scope. Inevitably, the expert contributors whom Harley and Woodward needed to recruit from among the handful of specialists then available had long been committed to older approaches, and they struggled with mixed success to fulfill their revisionist editors' pressing call for greater openness and contextualization (see Talbert 2008). Despite these limitations, however—indeed almost because of them—there is no question that this 1987 volume has achieved the status of a touchstone. It is an indispensable synthesis, marking a vital shift to fresh approaches and stimulating a rush of productive new studies which still continue to appear. The prediction that, whenever a second edition is commissioned, its emphases and perspectives are sure to be substantially altered in the light of the impact made by its forerunner should be taken as a handsome and well-deserved compliment.

Twenty years on from 1987, the Newberry Library's decision to make antiquity the focus of the sixteenth series of the Kenneth Nebenzahl, Jr., Lectures in the History of Cartography furnished the ideal opportunity to offer a rich sense of current approaches and understanding. The seven lectures as published here are designed for a wide (not narrowly specialist) readership, and their conjectures, claims, and conclusions are offered without false confidence. Good scholarship is always a work in progress, and while views articulated in 2007 may well be an advance on established opinion, they in turn are sure to be modified further over time. In recognition of how much coverage a single series can meaningfully accommodate, the library's choice to confine the 2007 lectures to antiquity was sound. Even so, a series still offered sufficient scope for the

interrelated civilizations of Mesopotamia, Egypt, Greece, and Rome all to be included—in that order—over a span of approximately two and a half millennia. To invite such inclusiveness is especially valuable because so few serious attempts have been made to address mapping within these four civilizations together.

Single lectures were given on mapping in Mesopotamia and Egypt by Francesca Rochberg and David O'Connor, respectively. For Greek mapping, Georgia Irby first surveyed initiatives from Homer to Eratosthenes, that is, from earliest times to the third century BCE. Alexander Jones then discussed the intellectual background and outlook which led Ptolemy in the second century CE to theorize about making a world map based on Eratosthenes's framework. Michael Lewis discussed the instruments, techniques, and achievements of both Greek and Roman surveyors with special reference to the planning of roads, aqueducts, and tunnels. My own lecture argued that, for all its quality, the cartography of the two large Roman display maps best known to us was only a foundation that each designer in turn had determined to subordinate and exploit for the promotion of Roman imperial power and values. In the final lecture Benet Salway examined texts of many different kinds as a means of gaining a more distinct impression of how Romans and other inhabitants of their empire used maps (if at all), constructed "mental maps" of it, and oriented their worldview.

To be sure, our endeavors have brought both frustrations and rewards. Outstanding among the former is the sheer unevenness of the survival of maps, map-like images, and writings about cartography. Of the different materials used, clay has in fact survived best. As Rochberg explains, so many maps on cuneiform clay tablets from Mesopotamia are known that she could not possibly discuss them all. At Tell el Amarna, an archive of cuneiform clay tablets has been recovered from the brief period when the city was Egypt's royal capital. Elsewhere in Egypt to date, there has been so little archaeological investigation of settlement sites (as opposed to temples or tombs) that the degree to which even Egypt's elite used maps still remains obscure for lack of evidence. It is true that by contrast quasi–"world maps" survive there as large, highly visible features on external wall faces of temples; even so, O'Connor cautions, there can only have been limited access to such images, because Egyptian temples were set within walled enclosures to which entry was carefully controlled.

The loss of so much Greek geographic writing and the maps associated with it, while far from exceptional when measured against such losses as a whole, leaves us with a patently inadequate grasp of the successive formative contributions to cartography made above all by early Ionian thinkers, as well as later by Eratosthenes, Hipparchus, and Marinus. Too often such knowledge as we can recover about them must be gleaned from hostile critiques by later authors, Strabo and Ptolemy especially. Indeed, we would not know of Marinus at all but for Ptolemy's attacks on him, which (ironically) betray how much Ptolemy in fact owed to him. Fate has seen to it, however, that Ptolemy's *Guide to Geography* survives complete, while Marinus's work—both writings and maps—is utterly lost.

In the Roman case, the major losses include the means to reconstruct the design of the surveyor's deceptively simple tools, the groma and the libra (for horizontal and vertical planes, respectively), from either texts or images, let alone from the recovery of sufficient parts of an actual example. For this reason among others, as Lewis demonstrates, we can only speculate about how the astonishingly straight alignments of Roman roads over such long distances were achieved, or how aqueduct channels were laid out and graded to ensure reliable delivery of water from faraway sources. Lost, too,

with no hope of recovery are all large Roman display maps beyond fragments of several inscribed on stone and a not quite complete medieval copy of another—the so-called Peutinger map—drawn on parchment (which need not have been the material used for the original). Most frustrating is the loss of the famous large map commissioned for display in Rome by Agrippa at the end of the first century BCE. We are consequently incapable of gauging either how it represented Rome's new domination of the entire Mediterranean and far beyond or the degree to which the underlying framework of its physical landscape reflected the cartographic advances made by Eratosthenes and his successors in Alexandria. Our difficulty in tracing connections and influences in this instance is indeed only one case among others more serious. Earlier, too, we must be right to imagine that Ionian thinkers' ideas about worldview and mapping were stimulated by contact with the Near East and Egypt, and that the same applies in the case of Greek techniques for surveying and tunneling. However, the means to achieve more nuanced insight into how such influences were transmitted and adapted is still to be found.

Ever since its rediscovery in the Renaissance, Ptolemy's *Guide to Geography* has been admired and valued for its proud commitment to "unpolitical" precision and comprehensiveness as well as for its preoccupation with projection, so that the maps made following its instructions should actually acquire the appearance of part of the globe. Ptolemy brought to the cartography of the globe a philosophy and certain key principles developed for his earlier compilation of a star catalog; that task no doubt held stronger appeal for him, because he considered astronomical measurement more secure than terrestrial. By formulating and applying a further set of theoretical principles, he sought to create a world map that was an exclusively geometric, scientific object. As Jones underlines, it reduced the location of principal physical features, settlements, peoples, and regions to nothing more than a set of coordinates which were in practice less accurate than they might appear. Ptolemy's distillation of geographic data in this form marks the culmination of efforts by Eratosthenes in the third century BCE to calculate the earth's circumference, to create a system of coordinates for it, and to subdivide its known, inhabited part (the *oikoumene*) into distinct regions ("seals," *sphragides*). Already in the fifth century Greek thinkers had reckoned both the cosmos and the earth within it to be spherical and had envisaged its division into five symmetrically balanced zones (one of them being the *oikoumene*), a concept which was to remain current through the Roman period and later.

Despite these remarkable Greek scientific initiatives, with their purpose of comprehending and representing both the earth and the heavens, it would seem justifiable to claim that throughout antiquity most people's engagement with maps—if they had any at all—was seldom likely to extend beyond the local level, where plans of landholdings, buildings, cities, mines, and the like were produced and consulted. This said, once Rome expanded and consolidated its control of much of Europe, North Africa, and the Near East, many educated Romans and others within the empire do appear to have gained some sense of its overall shape and of the relative locations of its provinces and principal cities. Salway reveals how we may infer as much from close attention to what the presentation of official Roman documents of various kinds takes for granted, likewise that of the itineraries commonly consulted for land travel. Just by what means this emerging "mental map" of the empire as a whole and its major components was acquired, however, remains an intriguing puzzle awaiting further investigation.

Egypt and Rome stand out as the two societies which each in their individual ways

developed the exploitation of maps or maplike images for purposes that reduce any practical function to secondary significance. In particular, designers in both these societies grasped the potential for projecting their state's power through cartography. Accordingly, maplike images form a striking feature of Egyptian temple art that celebrates victories won by a ruler, distant expeditions, and even control of the world. In one notably imaginative scene on the external face of the north wall of the great hypostyle hall of the Karnak temple in Thebes, the imperial god Amun-Re leads to the king Seti I a list—tethered by a rope—of topographical names that together (from Egypt's perspective) constitute the world's foreign lands and peoples. A Roman designer with comparable wall space at his disposal inside a hall in a temple complex had the vision to grasp the impact that could be achieved by inscribing there an assemblage ("mosaic" in modern cartographic terminology) of the surveyors' official large-scale plans for the city of Rome in its entirety at ground level. No human viewer would ever be able to examine all the detail reproduced there close-up (though a god could—the kind of consideration that may have occurred to Egyptian designers too). Even so, the general impression of power, pride, "civilization," and control made upon human viewers by the huge city presented thus must have been nothing less than awesome.

Comparable in imagination, but altogether more radical in its design, is the Peutinger map of the known world under Roman sway. There can be little doubt (as I argue in chap. 6) that its designer relies in the first instance upon a physical landscape base of the type developed by Eratosthenes. He has the temerity to distort it massively, however, so as to fit the vast span from the Atlantic to India within a most elongated, but squat, frame, one that moreover features the city of Rome as its center point! In consequence, seas are contracted, landmasses remolded, and (perhaps a further innovation) land routes traced throughout the empire and beyond to the east. Cartographically informative the bizarre result may still be in some respects, but its main aim is rather to project Roman values through a cartographic image—pride in peace, for example, urbanization, order, inclusiveness, ease of communication.

It emerges clearly that in none of the civilizations encompassed by this volume was there much development of uniform standards or expectations for maps. That is hardly a surprise, perhaps, given how little standardization there ever was in any aspect of ancient life. Even so, it is a fundamental insight to keep in mind, given our predilection for expecting "progress" and our tendency to assume too readily that many modern standards were also applied in the past. With reference to Mesopotamia, Rochberg delivers an important caution: "Extant cuneiform maps cannot be considered to constitute a coherent tradition of cartography in which a continuous evolution of mapping techniques or even conceptions of the map itself are evident over time" (p. 13). Indeed, none of the languages used by the civilizations featured in the volume is known to have settled upon a term which unequivocally signified "map" as we would understand one; instead, broader terms, which had to be interpreted in context, continued to be used. The very concept of a map remained loose, therefore, and we must be prepared to consider that the purpose for which one was made may not necessarily correspond to the obvious in the eyes of the modern observer—as in the case of the Turin papyrus map from Egypt. There were no equivalents either to the abstract "cartography" or to the collective "atlas" (nineteenth- and sixteenth-century formulations, respectively, in fact); attestation of groups or sets of maps is in any case minimal. Mass production of identical copies of any complex map was in effect impossible. Antiquity lacked the means to measure time or distance with precision, as

well as universally adopted units in which to record the latter in particular. Irby reminds us that even the length of the "stade" which Eratosthenes chose as the unit for recording his calculation of the earth's circumference is not certain (there were several Greek "stades," of differing lengths).

Cultural values, too, might impose restraint. These civilizations seldom placed a high premium on exploration, say, or on aggressive expansion of trading markets, nor were their religions (before Christianity) strongly motivated to proselytize. In the case of Egypt, moreover, O'Connor observes that the functions and "decorum" of temples and tombs "would militate against the depiction or inclusion of topographically accurate maps or plans in our modern sense" (p. 49). Elite Greek and Roman education always remained unavowedly rhetorical and literary, rather than artistic or scientific. It is true that the cartography of Eratosthenes and Ptolemy favored the northern orientation (north at the top of the map) familiar today, but Salway's discussion leaves no doubt that a variety of alternatives continued to be preferred without comment or apology by other mapmakers and writers throughout the Roman period. Even in official documents there was no standard sequence to adopt in referring to the three continents (Asia, Europe, Africa) or in describing the principal regions or provinces of the Roman empire. For the latter purpose, it may be added, it was far from typical to begin from Rome itself; rather, for many Romans the Mediterranean Sea evidently became the pivotal feature in their worldview. Altogether, however, readers of texts and viewers of images would not have expected adherence to any set of norms of the modern type. By the same token, they cannot have been deterred or offended by the need to interpret a variety of differing perspectives; still less would they expect a map to include a "key" that explained symbols or linework styles or colors.

Except at the most local level, a high degree of geographic accuracy was not normally expected of maps. Rather, they were valued more as consciously selective aids to the efforts made by users to comprehend their place within larger and bewildering surroundings, not just the earth, but also the heavens and often an imaginary underworld. It need be no surprise that ancient mapmakers typically situated the area of their own people at the center of their presentations. Ptolemy's exceptional decision not to do this, but instead to present the world comprehensively in a scientific, "unpolitical" manner, reflects unusual detachment and confidence. Typically, too, in the minds of most users, maps were only one among several means by which they developed their worldview, and to them (unlike us) not even necessarily the most important means. Here the present volume with its chosen focus on maps inevitably falls short. Salway's contribution acts as a reminder that for a fuller understanding careful account must also be taken of texts and lists of all kinds. In particular, there is no question that an alert reading of Greek and Roman authors can uncover much about their worldview—among major ones, for example, Herodotus, Thucydides, Xenophon, Polybius, Julius Caesar, Pliny the Elder, Pausanias, and Ammianus Marcellinus. Research of this type has already proven very rewarding, but there is more to be done and the results are sure to be revealing.

At the same time, to hope for discoveries of fresh material is far from unrealistic. The so-called Artemidorus papyrus, only published in full in 2008, includes a substantial contemporary specimen of cartography recovered from classical antiquity, a find of extraordinary value despite all the controversies to which it predictably gives rise (Brodersen and Elsner 2009). The most fervent hope must be for the emergence of finds that will illuminate ancient Egyptian mapmaking. In the meantime Rochberg's

contribution leaves no doubt that the surviving record of mapmaking in ancient Mesopotamia—an amazingly creative and diverse range of accomplishment from the local to the cosmic, with a strong religious impulse—is at present quite unmatched for any of the other civilizations discussed. It is only fitting, therefore, that her most instructive contribution should open the volume.

# ONE

## The Expression of Terrestrial and Celestial Order in Ancient Mesopotamia

**Francesca Rochberg**

## I. Introduction

The earliest examples of historical maps are traceable to the ancient Near East (fig. 1.1), where first Sumerians and Akkadians, and later Babylonians and Assyrians, developed the landscape of Mesopotamia by building houses, temples, palaces, cities, and states. Sumerian and Babylonian iconographic representation of features of the land and the built environment is known for the entire history of the cuneiform writing tradition, from the early third millennium to nearly the beginning of our era in Late Babylonian texts. Because of the diversity of the source material, mapmaking in ancient Mesopotamia has not been studied as a thematically unified corpus. The aim here is to afford a general overview and to make some comments on the various Mesopotamian cultural contexts for mapmaking. Completeness has not been a primary objective. Because of the sheer number of examples it is not possible to discuss each and every map on cuneiform tablets.[1] The following overview will move from the large (or local) scale to the small (or global) scale, beginning with evidence for plans of houses and other buildings, then proceeding to field surveys, city maps, regional maps, a map of the world, and finally the establishment of a spatial organization in the heavenly cosmos. The discussion will therefore not be strictly chronological, but each section will proceed from earlier to later examples.

Even in the prehistory of the Near East, a "map" from the Neolithic site Çatal Hüyük in central Anatolia attests to social awareness of the inhabited place and its relation to its geographic surrounds. Found in 1963 by the archaeologist James Mellaart during the excavation of Çatal Hüyük near Ankara, Turkey, this 3 m red-brown polychrome wall painting, radio carbon dated to approximately 6200,[2] appears to represent the town itself with eighty rectangular buildings of varying sizes clustered in a terraced town landscape (fig. 1.2 and plates 1a and 1b). Mellaart noted the similarity of the representation of the houses to the actual excavated structures found at the site, that is, rows of houses built one beside the other with no space between them. The wall painting shows an active double-peaked volcano rising over the town, likely to be the 3,200 m stratovolcano Mount Hasan, which is visible from Çatal Hüyük. Lava is depicted flowing down its slopes and exploding in the air above the town. A cloud of ash and smoke completes the scene.[3]

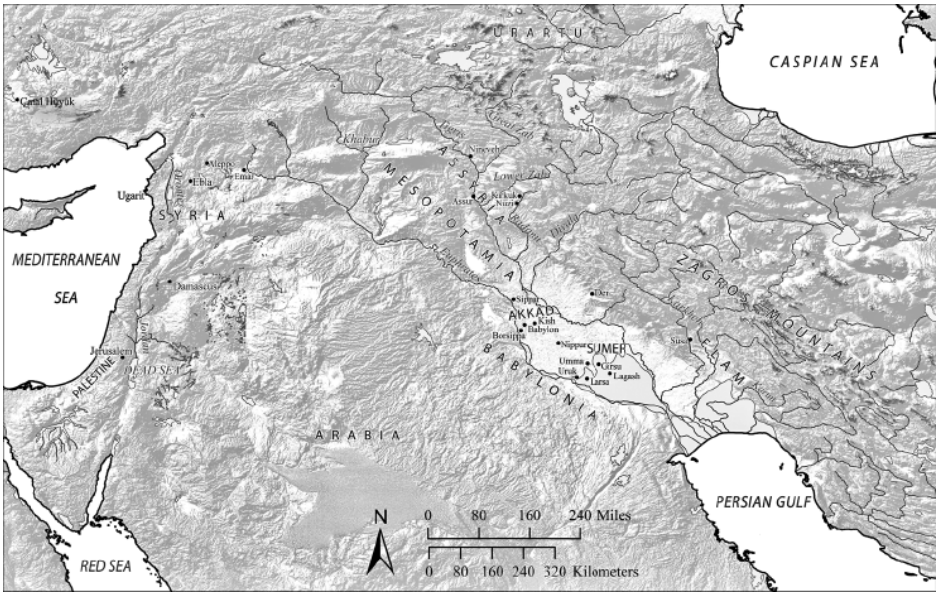



FIGURE 1.1 Map of the Ancient Near East. Adaptation by the Ancient World Mapping Center, University of North Carolina, Chapel Hill, of J. B. Harley and David Woodward, eds., *The History of Cartography*, vol. 1, *Cartography in Prehistoric, Ancient, and Medieval Europe and the Mediterranean* (Chicago: University of Chicago Press, 1987), 108, fig. 6.1.

While not a map in the sense of a surveyed and measured image of some part of the earth's surface, the image of the town with its local mountain spewing molten rock is a representation of a phenomenon that one can well imagine was actually experienced. In the context of other prehistoric European maps, Catherine Delano-Smith (1982) speculated that the representation of this geographic scene most likely had a ritual function. The map was not meant as a projection of a landscape upon a measured framework or even as a lasting representation, as the walls of the dwellings at Çatal Hüyük were regularly replastered and painted over. As Delano-Smith put it (1982, 18), "If villages and fields were depicted in it, they would have been associated less with the 'objective' recording of a spatial distribution for purposes of direction or reference than with invoking the favours of the controlling forces of those aspects of life these topographical features were used to represent or with attempts to appease them." Of course, such interpretations are conjectural in the absence of contemporary written evidence. As will be clear in this presentation, however, even in the presence of contemporary written evidence, the nature and motivations of mapmaking in the ancient Near East are not always easy to assess. The Çatal Hüyük map, while certainly not a map in the familiar sense, shares aspects with other ancient Near Eastern maps which reflect a desire to represent, for whatever reason, real aspects of the visible terrain of the immediate environment.

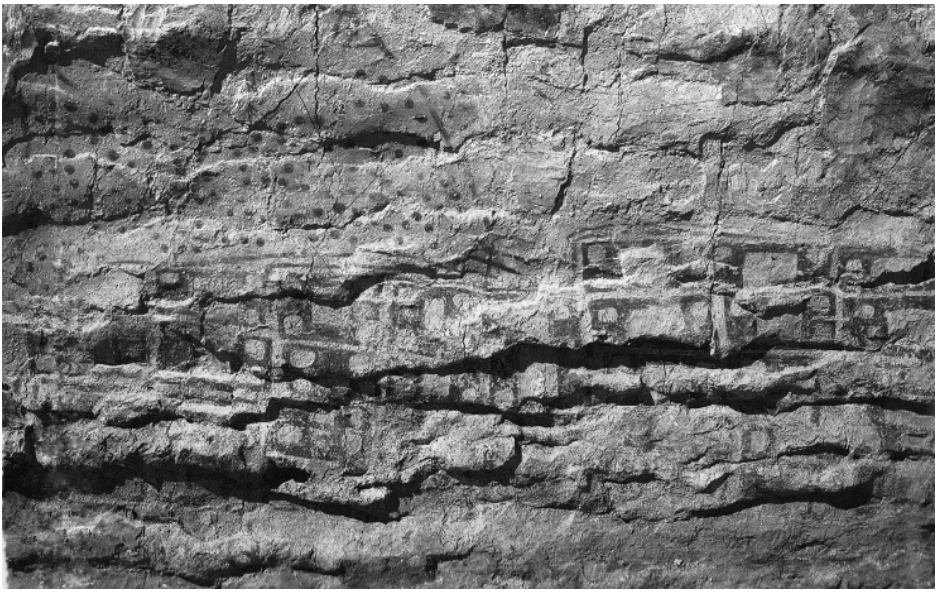


FIGURE 1.2 Part of a representation of a town in a Neolithic wall painting from Çatal Hüyük, Turkey, dated to the early seventh millennium BCE. Approximately 3 m in length. Image reproduced from J. Mellaart, "Excavations at Çatal Hüyük, 1963, Third Preliminary Report," *Anatolian Studies* 14 (1964): 55 and pl. V. Photograph by James Mellaart, reproduced with permission.

One of the functions of ancient Near Eastern maps is the representation of architectural or topographical order imposed on the physical landscape, or the idea of the physical landscape, both terrestrial and celestial. Mesopotamian maps do not guide the traveler from one place to another, but rather represent those ordered features imposed by human beings on the natural world, either physically, such as the temple, the city, agricultural lands, roads, and canals, or philosophically, as in notions of a world inclusive of known and unknown regions shown in diagrammatic form on the one surviving Babylonian world map. They are maps in the sense that a map is, as defined by Denis Wood (1992, 122), "an icon, a visual analogue of a geographic landscape . . . the product of a number of deliberate, repetitive, symbolic gestures . . . formal items—the discrete elements of iconic coding . . . shaped within the space of the map . . . or preformed and imposed on the map, activating formal symbolism and formal metaphor as well."

This definition of the map as an icon, and mapmaking as a process of developing iconic codes for representing topographical features, is useful for pulling together disparate sets of evidence that can be viewed together within a coherent framework of "mapmaking" in the ancient Near East. The features of the topography that eventually warranted representation, such as houses, temples, agricultural fields, and cities, distinguish undeveloped land from property. Mesopotamian maps were not exercises in the objective rendering of geography or the unbuilt landscape. One might say that land was not mapped; rather, property was. The reasons that made different kinds of property worthy of being mapped varied from economic to religious and cosmic.

Practical geography, on the other hand, is represented in literary form, in itineraries attested from Old Babylonian times up to Neo-Assyrian, that is, from the eighteenth to the seventh centuries. Their interpretation and their use for reconstructing ancient

landscapes is fraught with difficulty, because the identification of toponyms and their relative distances from one another is often uncertain.[4] The itineraries do often provide distances, given in months and days, or, in the case of the later examples, in the unit of distance and time called *bēru* (danna), which we translate as the "double-hour,"[5] and which was also adopted for use in measuring stellar and other celestial distances in astronomical texts. Indeed, the *bēru* was the pervasive measure of both distance and time in celestial terms, as it was a one-twelfth subdivision of the nearly constant unit of the day (ud), the interval between successive sunsets. The celestial "double-hours" stem from the correlation made between the length measure of twelve terrestrial *bēru* and the fixed time measure of one day (ud). In view of the term's Sumerian etymology—KASKAL.GÍD = danna, "long road"—the original length measure of the *bēru* referred to the distance traversable on foot in the time it would take for the sun to travel thirty degrees across the sky, or one-sixth the length of daylight (assuming an equinoctial day of twelve daylight hours). The distance of one *bēru* would then correspond roughly to a two hours' march. Such a correlation between terrestrial distances and the division into twelfths of the "day," or rotation of the sky, is, in a concrete sense, geodetic.

Not only on earth but in heaven too, structural order was imposed by the transposition and projection of terrestrial features of the built and cultivated environments from earth to heaven. The horizon was the "cattle pen,"[6] and the heavenly bodies the cattle and sheep that followed their orderly, or, in the case of planets, somewhat less orderly, paths (Rochberg 2010). The religious text *Enūma Eliš*, also known as the Babylonian Creation Epic, uses this double metaphor for the gods as both celestial bodies and livestock when it says, "Let him (the creator god Marduk) assign the regular motions of the stars of heaven; let him herd all the gods like sheep" (*Enūma Eliš* VII 131). In addition, the regular paths followed by the stars across the sky from their risings to their settings were compared to furrows of a field.[7] The fixed stars were also attached to specifically named "roads" serving to mark their directions, and the moon too moved against the starry background along what was called "The road of the moon" (*harrān* d*Sin*).

Other units familiar from the texts of land surveyors, the cubit or "forearm" and finger, are also found in astronomical contexts where distance between celestial bodies is in question. Despite a dearth of iconographic representation of the celestial roads and the arrangement of constellations within them, there survives noniconographic textual evidence making reference to double-hours, cubits, and fingers (*bēru*, *ammatu*, and *ubānu*, respectively) within the heavenly roads or with respect to other devices for fixing celestial positions, such as the ecliptical stars. These references show that such imagery and its associated metrology had currency throughout the cuneiform tradition of astral sciences. Celestial mapmaking, as we would recognize it, is not well represented, despite the application of units of time-distance such as *bērus* and degrees to the measurement of relative positions of celestial objects. Although the surviving iconographic evidence for "mapping" the heavens is extremely limited (see III.2 below), a practical astronomy that systematically organized, schematized, and predicted celestial phenomena shows that the celestial landscape was quite well "mapped," in fact.

Extant cuneiform maps cannot be considered to constitute a coherent tradition of cartography in which a continuous evolution of mapping techniques or even conceptions of the map itself are evident over time. Nonetheless, various aspects of the ancient Mesopotamian physical world, both terrestrial and celestial, are represented on cuneiform tablets over a considerable time span. These representations are eminently

classifiable as cartographic, even according to the definition of professional cartography by the British Cartographic Society as "the science and technology of analyzing and interpreting geographic relationships, and communicating the results by means of maps" (Harley 2001, 151).

Mesopotamian maps have not always been readily incorporated into the history of cartography. In older scholarship resistance to including them can be found even with regard to the best-known example, the so-called Babylonian *mappamundi* from the later eighth or early seventh century. In his introduction to the 1959 reissue of Edward Bunbury's 1883 *History of Ancient Geography among the Greeks and Romans from the Earliest Ages till the Fall of the Roman Empire*, William Stahl characterized this map as a crude representation (p. iii): "Before the time of the ancient Greeks, geography and cartography were in a primitive state. The early Babylonians, for example, had developed remarkable precision and skill in observing and predicting the orderly movements of celestial bodies, but their conceptions of the earth were what one might expect of a relatively isolated people. A Babylonian clay tablet . . . depicts the earth as a circular plane, bisected by the Euphrates River, with the capital city of Babylon located near the center and a few adjacent countries bordering upon an encircling ocean." Stahl's condescension takes it for granted that the map was intended as a direct and accurate rendering of its subject, and that its maker was a scientist with goals of precision and accuracy. However, such a position assumes criteria for mapmaking that will not be met by most ancient Near Eastern exemplars.

Recent cartographic historiography has revised the concept of what a map is (or what it is to make a map) and has consequently opened the way to consideration of maps as representations not only of the environment as a physical object, but also of notions of the environment, imagined, abstracted, or ideal realms of the world beyond the concrete features of the immediate experienced terrain (MacEachren 1995, 255–56). In particular, Brian Harley has articulated again and again the value of reassessing the history of maps and redefining cartography in accordance with evidence of its practice rather than by a priori modern criteria. As a result, he uncovered a deep level of humanity in maps, ancient and modern, and showed how maps invariably reflect culture and subjectivity: "As mediators between an inner mental world and an outer physical world, maps are fundamental tools helping the human mind make sense of its universe at various scales. Moreover, they are undoubtedly one of the oldest forms of human communication. There has probably always been a mapping impulse in human consciousness, and the mapping experience—involving the cognitive mapping of space—undoubtedly existed long before the physical artifacts we now call maps" (Harley and Woodward 1987, 1). What follows will summarize the evidence for maps and mapmaking in historical ancient Mesopotamia. Both maps that represent ideas of the landscape and those that represent its actual features are included; the line separating these is not always easy to define.

## II. The Terrestrial Landscape

### II.1. BUILDING AND FIELD PLANS

*II.1.a. House and Plot Plans.* At the most localized level, there survive tablets on which plans for houses and urban plots are drawn, accompanied by various kinds of inscription. House plans, showing walls and doorways, come from a wide chronological span, from the Old Akkadian and Ur III to Old Babylonian and Neo-Babylonian periods (ca. 2350–400).[8] Early examples are also known from third-millennium Girsu, although it is

difficult to identify with any certainty what kind of buildings they represent.[9] A well-preserved house plan from Ur III Umma shows dimensions in cubits, probably in reference to the dimensions of the rooms themselves.[10]

The ground plans of houses etched into clay tablets show walls by parallel lines, and in what seems to be a real representation of the floor plan they indicate the placement of doorways (see fig. 1.3). Sometimes doors are indicated by a pair of cuneiform wedges as though to mark a break in the wall, or even by hatch marks perpendicular to the wall. One Old Babylonian building plan—dated to the reign of Abi-Ešuh and inscribed with the description "plan (literally 'drawing') of a house of Sippar-Jahrurum"—includes labels for the various rooms and parts of the building, such as doors (KÁ = *bābum*), under the stairs (*šapal simmilti*, written GIŠ.KUN4), a reception room (PA.PAH = *papāhum*), and a barbershop (É ŠU.I = *bīt gallabim*).[11] These indications would suggest that the building had some sort of public function, though it is apparently not a temple.[12] Such labeling of rooms, or parts of a building, is also to be seen in an earlier plan from third-millennium Girsu: it mentions a courtyard (KISAL = kisallu), reception room (PA.PAH = *papāhum*), and living quarters (KI.TUŠ = *šubtu*), and gives the length and width of rooms measured in cubits (KÙŠ) and ropes (NINDA.DU).[13] An Ur III tablet from Nippur offers a further example of a building plan in which rooms are labeled: it represents a building containing a kitchen (É.MU), a washroom (É.LUH), a weaving room (É.UŠ.BAR.RA), and an archive, or "tablet room" (É.DUB).[14]

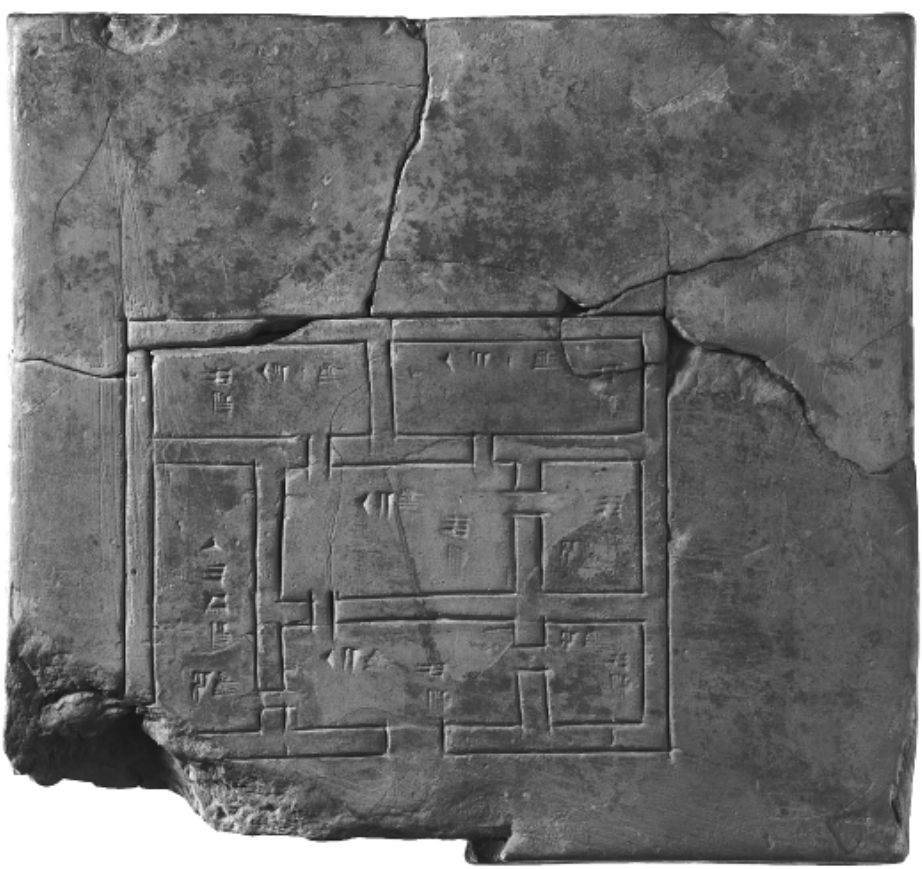


FIGURE 1.3 Ground plan of a residence in Umma with central courtyard, Ur III period. Vorderasiatisches Museum, Berlin, VAT 7031. Photo: Olaf M. Teßmer, Vorderasiatisches Museum—Staatliche Museen zu Berlin. Reproduced with permission.

Early house plans, such as from the Old Akkadian to the Old Babylonian periods, may well represent sketches, or scribal exercises, rather than true blueprints (see figs. 1.4 and 1.5). In the Neo-Babylonian period similar schematic house plans exist from the Nappāhu family archive (Baker 2004, 16). In addition to these documents, other Neo-Babylonian tablets, many of which are from Babylon during the reign of Darius I (522–486), preserve surveyed plans of urban plots in records of a land registry for both plots and fields, perhaps for the purpose of taxation. They do not show house plans, but merely the plot itself in relation to its surrounding streets or other properties;[15] they provide measured boundaries and a total surface area of the property, a four-sided single plot with an occasional adjacent plot represented in addition. The houses so described in these plans are small (under 200 sq m) as compared against actually excavated houses. Various explanations are possible: they may have been additional rental properties, or the small-sized properties were only thus on the plan, whereas the actual area formed part of a larger house unit, not divided physically (Baker 2004, 62).

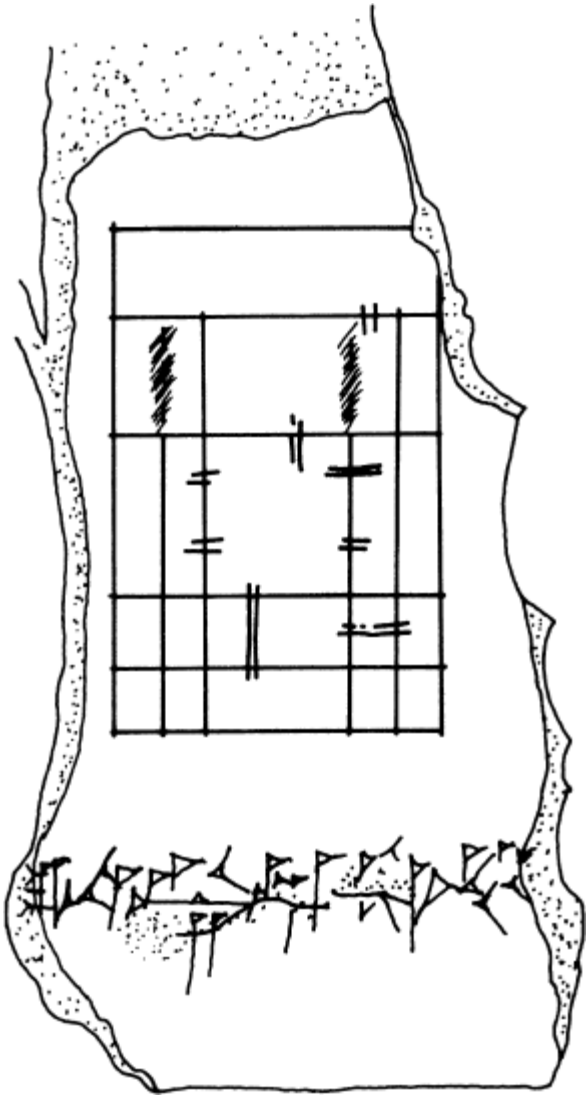


FIGURE 1.4 Modern redrawing of a Middle Babylonian plan of a house with courtyard. Original in Iraq Museum, Baghdad, IM 44036, 1. Reproduced from Joachim P. Heisel, *Antike Bauzeichnungen* (Darmstadt, Germany: Wissenschaftliche Buchgesellschaft, 1993), 35, with permission of the publisher.

The "maps" which document the delimitations of properties served a social and economic function of controlling real estate. Archival sources dealing with inheritance, sales, and rents confirm that the ownership of real property was a significant issue in Mesopotamian society over the course of its history. As Heather Baker (2004, 60) has pointed out, the house plans "are very similar in their basic configuration to the textual descriptions of houses, that is, they represent the sides of the property according to the points of the compass, labeled according to the neighboring property-owners and/or topographical features (usually streets) on each side, giving the measurements of the property's boundaries plus the total surface area. Usually each plan consists of a single four-sided plot, but occasionally an adjacent plot is also depicted, according to the

requirements of the survey." From the point of view of function, then, the graphic documentation of houses and plots, as with the field plans (to be discussed below), played a role in the control of property ownership. From a cartographic viewpoint, the representation of houses and building plots and the use of certain iconic conventions for showing walls and doorways probably indicate a relative standardization effected by the training of the scribes who drew up the plans.[16]

FIGURE 1.5 Middle Babylonian house plan inscribed with dimensions of walls (?). The British Museum, BM 80083. Reproduced with permission.

*II.1.b. Temple Plans.* The conventions for house plans were also employed in representing the more elaborate houses of the gods. A number of temple plans on clay tablets are known, even though it is not possible to identify the names of either the deity or the temple in any instance. Such plans may be scribal exercises, or sketches, as is most likely the case in a tablet of uncertain provenance and date (possibly Middle Babylonian or later): it shows a building complex within which is an isolated smaller structure labeled "sanctuary" (*aširtu*) and comparable to northern temple architecture of the "bent axis" type.[17]

Several plans incised into clay tablets represent the stepped "ziqqurat" form of the traditional ancient Mesopotamian temple platform. One of these, from Nippur and of uncertain date (Old or Middle Babylonian), appears to present seven graduated levels in a square formation, and has inscribed on it a reference to an exorcistic purification ritual "to abolish (literally 'smash') what is evil" (hulu dúb).[18] In the central portion of this plan, within what appear to be rooms surrounding the uppermost level are additional references to ritual objects: "pure (metal) hand," "pure (metal) pedestal," and a golden

dagger and vessel.[19] A Late Babylonian clay tablet with a drawing of a ziqqurat on both obverse and reverse does not permit a count of the levels, though on one side there are at least six.[20] Another Late Babylonian tablet, probably from Babylon, is a representation of a seven-stepped ziqqurat. The overall dimensions are such that the height, length, and breadth are all equal, measuring 42 cubits (21 m), and each level increases in equal steps by ½ GAR (3 m) per tier.[21] Excavated ziqqurats, such as at Ur (62.5 × 43 m wide and high) and Dur-Kurigalzu (ʻAqar Quf) (69 × 69 m) are considerably higher, although the base (*kigallu*) of the E-temen-anki at Babylon was identical to this one, according to the E-sagil Tablet (AO 6555:19). While this ziqqurat plan could well be didactic or simply idealized, it certainly reinforces the likelihood that scribal training included plans of buildings and their mensuration (Wiseman 1972, 143–45).

From ca. 2100 we find the plan for a monumental temple drawn on a 93 cm high inscribed diorite statue of the ruler Gudea of Lagash (fig. 1.6).[22] The king is portrayed as an architect or builder, sitting with his ground plan for the E-ninnu temple of Ningirsu, which was excavated by Ernest de Sarzec in 1880 in the city of Girsu (modern Tello).[23] The inscription identifies Gudea as one handpicked by the god Ningirsu "from among 216,000 (= $60^3$) persons" to shepherd his land (Edzard 1997, p. 32 iii 9–10). On ritually clean ground, he built the E-ninnu, which "raised its head to heaven," an expression that would become a literary trope applied to other cities and temples, culminating perhaps in the very name of the temple of Marduk at Babylon itself, the E-sagil, "house whose head is raised (high)." The cedar timbers used for building E-ninnu were procured from distant forests of the Amanus mountain range in Syria, the road to which Gudea says Ningirsu "opened for him" (Edzard 1997, p. 33 v 21–27). The stone slabs for the stelae (monuments) set up in the temple courtyard were also brought from the western mountains; other rich materials, copper and gold, were brought in from long distances to the west and east (Elam, Meluhha). The statue's inscription, therefore, tells not only of the building of E-ninnu, but also of the geographic knowledge of distant lands, as well as access to them and control of their resources. Moreover, on the board that rests on Gudea's knees (fig. 1.7), beside the building plan, are the tools of the architect and mapmaker, the stylus and a graduated ruler, sometimes called the "cubit of Gudea."[24] The measurements of this cubit have been the subject of discussion, with various values given, but all approximating 50 cm (Powell 1987–90, 462 sub §I.2.e).

FIGURE 1.6 Detail of life-size diorite statue of Ensi Gudea of Lagash with the building plan of the Ningirsu temple. Musée du Louvre, AO 2. Photo: Erich Lessing/Art Resource, NY. Reproduced with permission.

By the late third millennium, it was customary to draw preparatory plans for buildings on clay (Donald 1962, 190). Representations of temple plans on stone are in a different class, however. The fineness of the drawing and the presentation of the plan on Gudea's lap—with not only the plan, but also the text describing the construction of the E-ninnu with its architectural details, carved in stone on the lower part of the body of the king—reflect an ideal. It is, so to speak, a representation of a representation, and never meant for "use" as a blueprint. This E-ninnu plan confines itself to the area enclosed by an external wall, with its merlons and crenels and six similarly crenellated gates appearing as battlements, giving the whole a castellated effect. It has been

suggested by Wolfgang Heimpel that the six gates in the building plan are to be correlated with the six gates mentioned in Gudea's Cylinder A describing the statues, standards, and figures that he placed at each one.[25] Representation of such monumental temple construction on clay can also be seen in a fragment of a tablet from Girsu.[26]

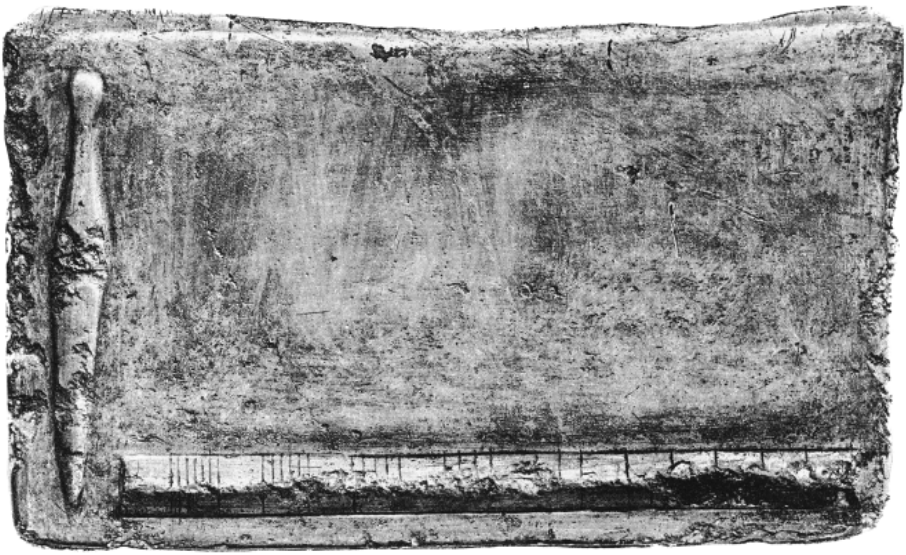


FIGURE 1.7 Tools of the architect and mapmaker, the stylus and a graduated ruler, on the lap of Gudea of Lagash. Musée du Louvre, AO 4. Reproduced with permission.

Later texts that document the names and epithets of sacred buildings in the major Babylonian and Assyrian religious centers, Uruk, Ur, Kish, Nippur, Assur, and of course Babylon, can be viewed against the background of geographic and topographical Sumerian lexical texts as well as of hymns venerating cities and temples (George 1992, 1–2). Later, after the Old Babylonian period and the decline of the Sumerian literary genre of city and temple hymn, a similar purpose came to be served by scholarly tracts in list form such as the compilation "Tintir = Babylon." These glorified a city's cosmological centrality and sacred status by a comprehensive list of its epithets, temples, and shrines.[27]

The two representations of temple plans in stone, one on the statue of Gudea, the other on a stele of Nebuchadnezzar II, both refer to significant architectural monuments, the E-ninnu and the E-sagil. These plans, unlike those preserved on clay, are an iconographic expression of glorification along the same lines as those identified by Andrew George for the scholarly lists. The E-ninnu plan is presented on the lap of Gudea in reverential demonstration of that ruler's piety, and the plan of the E-sagil and the image of the ziqqurat E-temen-anki are shown atop a stele of the Neo-Babylonian ruler Nebuchadnezzar II, where he too is shown beside these images as well as below them in an attitude of devotion and dutifulness.[28]

The Late Babylonian (third-century) "E-sagil Tablet" concerns the dimensions of the E-temen-anki using two different cubit standards, an early (Kassite and Early Neo-Babylonian) and a later (Standard Babylonian) one. The cubit, or "forearm," was the Mesopotamian (Assyrian and Babylonian) standard linear unit of measure based on the distance from the elbow to the tip of the extended middle finger and was used from the

third millennium (Old Akkadian period) onward.[29] It served to measure lots, fields and orchards, walls and other constructions, timber and beams, garments, and even the heights of people.[30] After determining the areas of two courtyards outside the Temple E-sagil proper, in the didactic form of a mathematical problem, the E-sagil text goes on to calculate the area of the base of the ziqqurat E-temen-anki from its length and width. The linear measure of length and width, using the later Neo-Babylonian cubit standard, is then converted to capacity-surface measure, that is, in terms of the volume of grain needed to seed such an area (in the standard equivalence 30 sila [or 1 *ṣimdu*] of seed to 1 *ikû* of land) (George 1992, 109–12). This conversion of linear to capacity measure is paralleled in the surveying of fields, first measured in cubits and then converted to a seed or other measurement (Nemet-Nejat 1982, 143–44).

Temple plans continue into the Neo-Babylonian period, as in the plan on a large clay tablet (23 × 31 cm) from Sippar that shows crenellations or buttresses in the outer wall, with bricks in a grid formation, and indicates the cardinal directions on the outer margins of two sides (fig. 1.8). Locations of doors are inscribed, as are other parts of the sanctuary; in the inside of the grid there is noted: "[n cubits, n] fingers (*ubānu*), the length of the storehouse of the northern gate."

*II.1.c. Field Plans and Cadastral Surveys.* Drawing plans for real estate, including houses, plots, and fields, was part of professional scribal work, and it is possible that the same official, the *šassuku* (who assessed land and property for taxes), also measured, surveyed, and drew plans (Nemet-Nejat 1988). Actual surveying techniques are difficult to reconstruct for lack of evidence, but the third-millennium technical term gag . . . dù, "to drive in the peg," in sale documents refers to holding a measuring line down by driving a nail or peg into the ground, a practice that may later have been reflected in the insertion of a clay nail into the wall of a house along with the sale document. There is again testimony to surveying in a group of mathematical texts which refer to a broken reed used in measuring a field.[31] Literary evidence, too, confirms the connection between real estate and field surveying with the measuring line held by the peg. Thus, in a Sumerian disputation Enkimansi and Girinišag accuse one another: "You go to divide up an estate but are unable to divide up the estate. For when you go to survey the field, you cannot hold the measuring line. You cannot hold a nail in your hand" (Kramer 1963, 241).

Evidence for surveyed and measured parcels of land is to be found, for example, in Kassite-period (ca. 1400) boundary stones (*kudurru* texts), which legally document the granting of land by the king to a subordinate (*ardu*). Beginning in that period, *kudurru* texts show that fields are measured in "seed" (ŠE.NUMUN) and by the "great cubit" (*ammatu rabītu*) in accordance with a standard ratio of the amount of seed to the area of land (30 sila of seed to 1 *ikû* of land), having its origins in actual seeding practices of the Ur III period and continuing through the old Babylonian period, attested in evidence from Susa (Powell 1984, 35). In the context of fields, the capacity measure shows that the value of land was linked to yield capacity. The *kudurru* of Adad-zēr-iqīša notes the name of the surveyor of the field (*māšihāni eqli*, "the person who has surveyed the field"),[32] as well as giving its location and size.

*A*

*B*

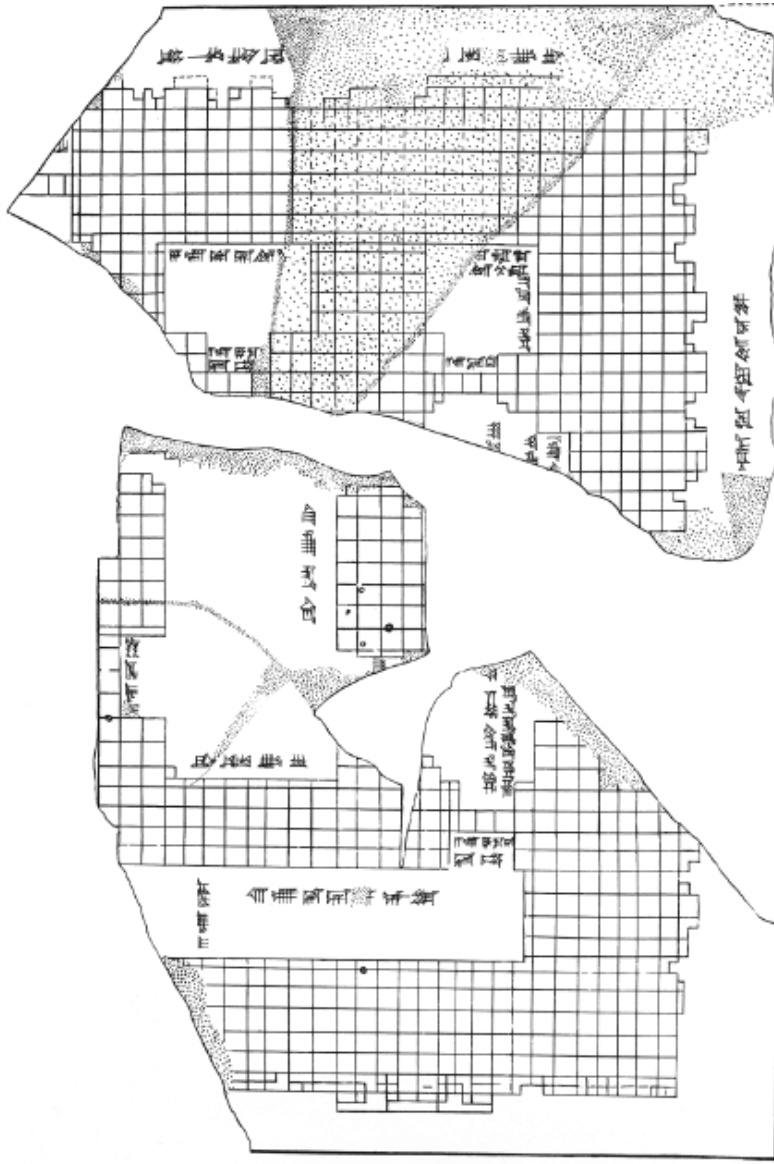


FIGURE 1.8 *A*,Temple plan on a Neo-Babylonian tablet from Sippar. British Museum, BM 68840—68845. Reproduced with permission. *B*, Modern redrawing.

It is difficult to reconstruct the topographical aspect of Mesopotamian agricultural lands, their precise features and dimensions. Archaeology can do only so much to realize macrostructural ancient landscapes by locating settlements, fields, and canals. Microstructural features are accessible through two types of documents relating to the shape and size of fields: plans, measured and drawn to scale, and cadastral surveys giving dimensions of the sides of fields oriented to the cardinal points. As is the case in other types of plans (house, plot, or temple), it is difficult to know whether the field plans and surveys have been produced in an actual administrative context as sketches for the preparation of land tax or sale documents, or whether they are only models for teaching surveying techniques. If the tablets with detailed plans of fields are models, not

real cases, obviously they do not shed much light on ancient topography.

Thirty such field plans are extant for the Ur III period, between 2112 and 2004.[33] They demonstrate techniques of field surveying—specifically, the adaptation of irregularly shaped fields to regular rectangles with added or subtracted "appendages," often triangular in shape, or with long narrow strips, as was apparently common in the layout of fields to meet the needs of irrigation and of plowing with a heavy plow that was difficult to turn; see figure 1.9.[34]

The average Neo-Sumerian field was quite large, measuring 100 *ikû*, the equivalent of about 36 hectares, or nearly 90 acres. Earlier, in the Akkadian period, texts deal in much smaller-sized fields, between 4 and 10 *ikû*, perhaps because they were restricted to domestic rather than commercial use undertaken by large public (temple) institutions. In the administration of large commercial fields, also common were ½ fields (around 50 *ikû*), ¼ fields and ¾ fields, as well as "double fields" (around 200 *ikû*) and "triple fields" (300 *ikû*). Field text plans also reveal 1¼ (125 *ikû*), 1½ (150 *ikû*), and 2½ (250 *ikû*) fields. Mario Liverani (1990, 157–58) concludes that these figures represent "a rounding up of the original measurements of the fields with reference to a 'standard field' of 100 *ikû*, which is also the area of ground cultivable by one *apin*-plough under the direction of one *engar*-farmer."

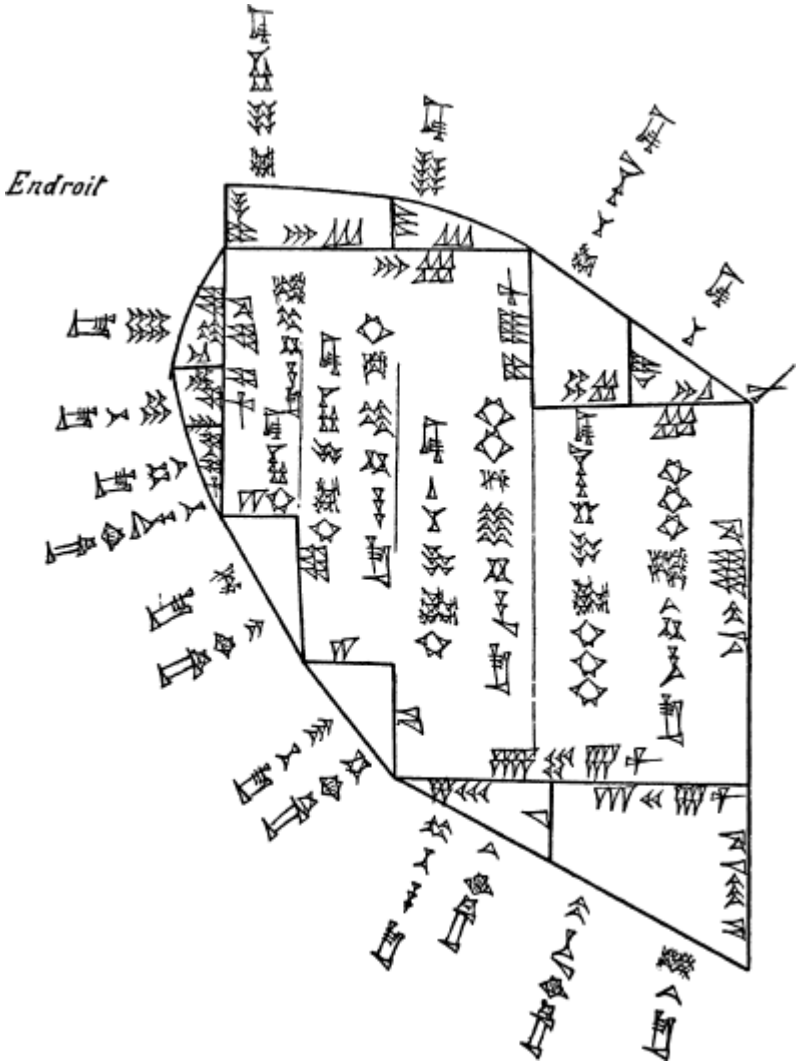



FIGURE 1.9 Modern redrawing of an Ur III field plan. Original in Eski Sark Eserleri Müzesi, Istanbul, ES 1107. Reproduced from F. Thureau-Dangin, "Un cadastre chaldéen," *Revue d'assyriologie et d'archéologie orientale* 4 (1897): 13.

The survey of one such agricultural tract, belonging to the city of Umma, is inscribed on a tablet that designates the field, measuring 4 BUR 2 iku (about 68 acres), as "the field of the irrigation ditch Guru" which belongs "to the goddess Ninurra."[35] This field plan is dated to King Bur-Sin of the Third Dynasty of Ur. The drawing on the tablet, not to scale, may have represented notes taken down for the purpose of calculating the area within the field's boundaries, which itself was necessary for figuring out how much seed grain was sufficient for planting such a field and how much yield to expect. As already indicated, such a conversion to surface-capacity measure points to the connection between the value of land and its economic productivity, as one would expect in an agrarian economy. Another field plan, from the city of Nippur and dated to the fifth year of Šu-Sin, shows a subdivided area of land allotted to several members of the temple personnel for their own subsistence. As was the case for irrigating the long fields of the Ur III period area of Lagash, this plan shows the strips of field aligned on the short sides

to a canal, permitting irrigation to go down the line of furrows (Zettler 1989, text 6 NT 777).

FIGURE 1.10 Middle Babylonian (ca. 1500 BCE) Nippur Field Plan showing the curvature of the watercourse and its irrigation canals. University Museum, University of Pennsylvania, CBS 13885. Reproduced with permission.

Finally, in this connection, a map (fig. 1.10) from Kassite Nippur (ca. 1500) situates a centrally located field "between the canals, 8 NUMUN of arable land, the field of the palace" (Langdon 1916). On either side are fields for the upkeep of the *bārû*, or diviner priests. The neighboring towns of Kar-Nusku and Hamri, known from temple records at Nippur, are designated as well as the distribution of watercourses, both large and small canals, and a marshland to the north of the palace field. At the top of the map we find the Field of Marduk, the national god of Babylonia, probably a field owned by the temple of Marduk, E-sagil.

**II.2. CITY MAPS**

Examples of city maps, some quite fragmentary, are preserved for Gasur (later called

Nuzi), Nippur,[36] Babylon,[37] Sippar,[38] and Uruk.[39] The ancient Mesopotamian city stands as the quintessential vehicle of self-identification in that fundamentally urban civilization (van de Mieroop 2004). Our knowledge of a Mesopotamian conception of "citizenship" is unfortunately quite poor, but a member of the community was identified as a "son of the city,"[40] and so the equivalent expression of the term "citizen," or something perhaps similar to it, is tied to the concept and word for the city. We cannot determine the precise function of the city maps, and one hesitates to suggest the anachronistic notion that their production hints at something akin to self-representation on the social level. Even so, while perhaps not consciously self-representational, a cuneiform city map was in fact a representation of a social and topographical phenomenon that functioned not only as political and economic center but also as the residence of a god in the Sumero-Akkadian pantheon. This was the defining function of a Mesopotamian city, and so a number of identities related to community, government, and religion were in fact integral to the character of any given urban center (Stone 1995, 235).

*II.2.a. Nippur.* In the third millennium, Nippur was the single most important religious center of all Sumerian city-states. It was the earthly residence of the god Enlil, divine ruler of the pantheon, where his temple E-kur, "House Mountain," was built. Not only had the city and its principal temple functioned as a sacred site for cult and ritual observance, but also ideologically Nippur represented the very center of the cosmos, as is clear from its epithet Dur-anki, "Bond of Heaven and Underworld."[41] In the fall of 1899, during the excavation at Nippur by the University of Pennsylvania, a 21 × 18 cm clay map was found (fig. 1.11).[42] Published only in 1955, it was subsequently analyzed by Samuel Kramer and Cyrus Gordon in 1956 (Kramer 1956, 271–75). Scholarly consensus dates the map to the Kassite period (perhaps fourteenth to thirteenth century) (Gibson 1977, 1978). This marks a time of renewed vitality for Nippur, which had been abandoned for several centuries since the Old Babylonian period (reign of Samsuiluna, eighteenth century) (Gibson 1978, 119n9).

If in fact the map was first drawn by Kassite scribes, it may indicate the reconstitution of Nippur's former glory with renewed building by Kassite kings. It represents, in the manner of house plans, the E-kur temple and its attached Kiur,[43] associated with the underworld. These buildings are shown with double lines for walls and with parallel crosshatches marking the positions of doorways, conventions employed in house plans. Also indicated are the An-niginna, a kind of enclosure, the Eš-mah, "Exalted Shrine," a city park named "Central Park," seven gates (including the Ur-facing gate and the Uruk, Gula, and Nergal gates), and two important canals, the Nunbirdu (Id-nunbir-tum) at the top of the map and the Center City Canal, appropriately named. Many features are given measurements in a standard Sumerian unit of length, the rod, or nindan (= 12 cubits).

FIGURE 1.11 Nippur city map drawn to scale. Frau Professor Hilbrecht Collection of Babylonian Antiquities, Friedrich Schiller University, Jena, HS 197. Photograph by Prof. Dr. Manfred Krebernik. Reproduced with permission.

With the aid of aerial photographs, and by study of archaeological remains and comparisons with the modern site plan of Nippur, Miguel Civil determined that the Nippur map was drawn to scale; he also found its orientation to be northwest to southeast. Not only is this map matched by the modern reconstruction of the site plan, but also when we read the Sumerian literary text "Enlil and Ninlil," set in the city of Nippur, we are placed in the very topography represented on the map. The poem begins:

There was a city, there was a city—the one we live in. Nibru was the city, the one we live in. Dur-gišnimbar was the city, the one we live in. Id-sala is its holy river, Kar-geština is its quay. Kar-asar is its quay where boats make fast. Pu-lal is its freshwater well. Id-nunbir-tum is its branching canal, and if one measures from there, its cultivated land is 50 sar each way. Enlil was one of its young men, and Ninlil was one its young women. Nun-bar-še-gunu was one of its wise old women.

Enlil and Ninlil are described here as an adolescent boy and girl, and the girl's mother, Nunbarshegunu, is there to advise. She says:

The river is holy, woman! The river is holy—don't bathe in it! Ninlil, don't walk along the bank of the Id-nunbir-tum! His eye is bright, the lord's eye is bright, he will look at you! The Great Mountain, Father Enlil—his eye is bright, he will look at you! The shepherd who decides all destinies—his eye is bright, he will look at you! Straight away he will want to have intercourse, he will want to kiss! He will be happy to pour lusty semen into the womb, and then he will leave you to it![44]

*II.2.b. Babylon.* In the seventh century the city of Babylon was restored to former splendor by the Assyrian monarch Esarhaddon (680–669). He describes the temple of Marduk as "the palace of the gods, mirror image of the Apsû, counterpart of E-sharra, replica of the abode of the god Ea, counterpart of the constellation Field."[45] The centrality of Marduk's earthly residence was supported by a religious and political mythology accounting for the ascendancy of Babylon and its god, Marduk, over all other Mesopotamian cities and all other gods. The creation poem *Enūma Eliš*, composed to celebrate the rise of Marduk to kingship over all the gods, constructs a cosmic geography in which Marduk's residence on earth is his city of Babylon, and this idea is further promoted in the theological text "Tintir" (George 1992, 6). Andrew George (1999, 69–70) discusses the fact that the religio-cosmic centrality of the city of Babylon lay in its role as the gathering place and home of the pantheon of all the gods of heaven and underworld. This ideology built upon a tradition already established in Nippur many centuries earlier: here Enlil's temple was a cosmic center and Nippur functioned as the meeting ground for the entire assembly of the gods.

A small fragment of a Late Babylonian map of Babylon (BM 35385) marks the great Shamash Gate, and beside it the toponym Tubaki shown near a watercourse indicated by parallel lines infilled with wavy lines (fig. 1.12).[46] The topographical text "Tintir" makes mention of the city quarter of Tuba: "From the Navel of the Bow of the temple of Bēlet-Ninua to the river bank is called Bab-Lugalgirra; From the Šamaš Gate to the river is called Tuba."[47] This text also describes Tuba as a city quarter of the "West Bank" (BAL.RI (*balar*) *ereb šamši*). Accordingly, George has reconstructed the map of Babylon from which the fragment came. A learned commentary on the topography of Babylon and the city's dimensions occupies the obverse of the same tablet. Among the subjects it treats is the city wall (part of which is visible on the map) and the location of all gates; these George (1992, 135–37) was able to include in his reconstruction on the basis of the metrological data provided by the commentary. Notably, the little that is preserved of the Babylon map has been drawn as though with a ruler; the lines indicating the wall and the canal are straight, and the waterway is marked with the wavy lines that conventionally symbolize water.

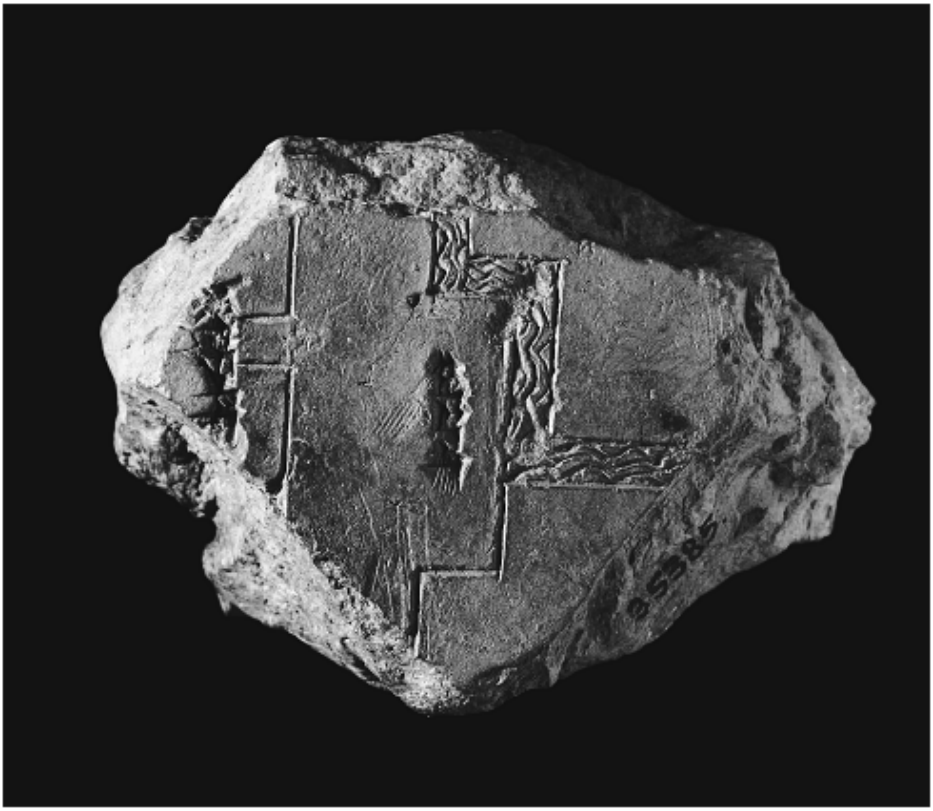



FIGURE 1.12 Map of Babylon showing the city quarter of Tuba by a watercourse. The British Museum, BM 35385. Reproduced with permission.

## II.3. REGIONAL MAPS

*II.3.a. Nuzi.* The oldest of cuneiform maps was discovered by the Harvard-Baghdad School Expedition in 1930–31 16 km south west of modern Kirkuk at the site of Yorghan Tepe (Meek 1932). Here, during the late third millennium, the ancient site of Gasur was a city with a palace and a temple complex, which is the typical urban structure found in Mesopotamian cities of both the south and the north until the Neo-Assyrian period of the seventh century. Among the five thousand tablets found during the excavation of Gasur (later renamed Nuzi after a major influx of Hurrian-speaking people in the middle of the second millennium) was a 7.6 × 6.8 cm tablet with a depiction of settlements or estates and their environs, the latter comprising hills and watercourses or irrigation canals, one of them called *Ra-hi-um*, presumably within the local area. The settlements are marked as circles, inscribed with the name of the place. The only one of these completely preserved is MAŠ.GÁN. BÀD *Eb-la*, meaning "Fortress of Ebla." At the center of the map there appears a circle without any inscription. To its left and right is an inscription indicating the size and ownership of the estate, specifically 354 *ikû* (approximately 128 hectares, or 318 acres) of cultivated land belonging to Azala, which could be the name of either a person or a place. Given its central location on the tablet, the natural inference must be that the map was produced specifically to clarify the location and size of this parcel belonging to Azala.

This earliest of cuneiform maps (fig. 1.13) is explicitly oriented, with the names of the winds written on the sides of the tablet. The top is identified as IM.KUR, "mountain

wind," or "east." Correspondingly, the bottom is IM.MAR.TU, "west wind," the left side is north (IM.MIR), and the right is south (the writing here is not preserved). Theophile Meek, the epigrapher for the Nuzi excavation, speculated that the map represented an area between the Zagros Mountains and the hills near Kirkuk. The watercourses indicated would then be identifiable as the Lower Zab, Radanu, Tigris, or perhaps just irrigation canals.

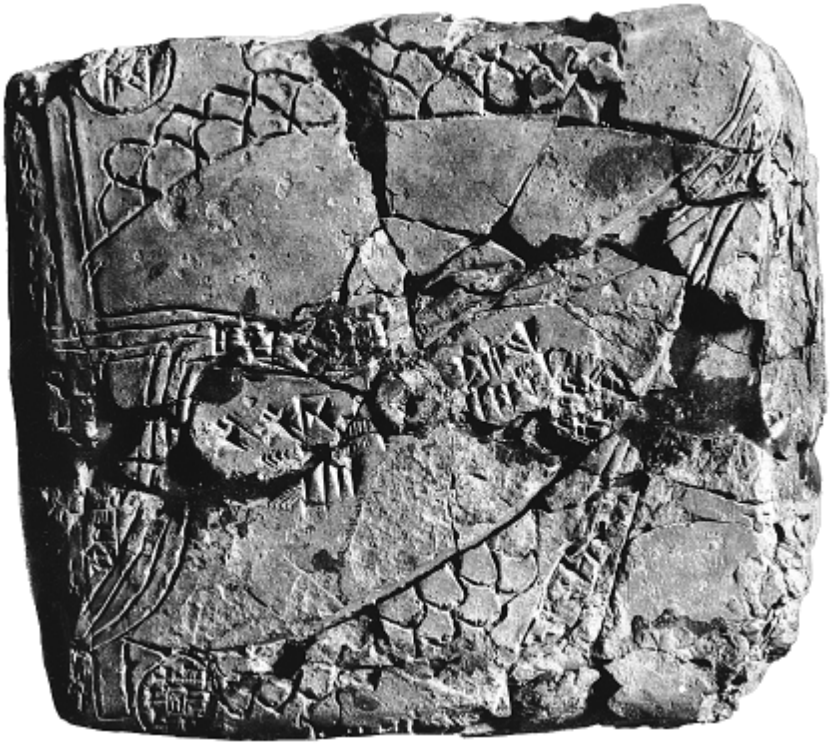


FIGURE 1.13 Akkadian-period (ca. 2400 BCE) regional map denoting cultivated land and its owner. Courtesy of the Semitic Museum, Harvard University, SMN 4172.

This Nuzi map is inscribed, and its synthesis of iconic symbols, topography, and script thus acts to convey its meaning. Two fundamental, if not almost universal, cartographic symbols occur on the map: the hill sign of overlapping humps, viewed from the side as it were, and the watercourse sign of parallel lines. It might be claimed that we recognize these signs so easily because they bear a visual likeness to the topographical features they represent. There is no guarantee, however, that hills will be drawn as rows of hummocks or rivers as parallel or wavy lines, and indeed such symbols taken out of context do not necessarily conjure up hills and rivers. At least it may be observed that these same icons bear resemblance to the abstracted and linear pictographic representations of hills and water seen in the early development of the cuneiform script.[48] Of course, by the date of the Nuzi map, these pictographic signs had already been long superseded by cuneiform ones. Nonetheless, the unified features of map icons and the precuneiform form of these word signs are noteworthy.

*II.3.b. Nippur.* During the third expedition of the University of Pennsylvania's excavation of Nippur a tablet was found with a map of at least seven cities (some, but not all,

written with the determinative URU, “city”) and their relative positions with respect to a canal called Tukulti-É-kur. This tablet (fig. 1.14) was published by Albert Clay (1905). He noted that several of the cities (or towns) mentioned on the map were identifiable with toponyms mentioned in temple inscriptions of the Kassite period (fourteenth century), specifically ones dealing with tax records, business documents showing transactions with income, receipts, and payrolls of temple and storehouse personnel.

FIGURE 1.14 Topographical map from Nippur. University Museum, University of Pennsylvania, CBS 10434. Reproduced with permission.

The canal, positioned down the center of the tablet, is represented by narrow parallel lines and is inscribed with its name, ÍDTu-kul-ti-É.KUR. Also more or less centrally located is a town of the same name, Tukulti-E-kur, marked as a small square incised with single straight lines. The other towns, too, are shown as squares. Near the bottom of the tablet, in what appears to be another canal, is the inscription "field of the town Similati" (*eqil* (A.ŠÀ) URU*Si-mi-la-ti)*. This Similati is also shown on the side of the tablet, marked by a square. Clay conjectured that the writing *eqil*, "field of," was a mistake for *nār*, "canal of," though it could simply be a consequence of the inscription's placement inside the lines representing the waterway instead of below them. In any event, the mention of a field here does not seem too incongruous. There are no measurements on this map, only relative positions. The reverse of the tablet does not seem to be inscribed, although a portion of the right-hand side is broken off. For what purpose this map was drawn is difficult to know, but it seems connected to the temple administrative documents making mention of the tax records from these same named districts outside Nippur, exploited for maintaining the E-kur temple during the Kassite period.

### II.4. MAP OF THE WORLD

A Late Babylonian tablet (BM 92687), copied from an older original, contains a written description and a diagrammatic image of the world as conceived sometime after 900 (fig. 1.15).[49] Its provenance is uncertain, but its British Museum catalog number and the onomastics of the scribe who copied the tablet point to the city of Borsippa. The description written to accompany the map has an integral, but complicated, relation to the image (Horowitz 1988, 153). This world map is best matched with the category of medieval maps termed *mappaemundi* (see further chaps. 6 and 7 below). It depicts a geographic totality that includes the local environment but is not limited to it. Circles represent cities (as in the Nuzi map), and parallel lines rivers. The largest demarcated area, shown as a rectangle on the upper central portion, is Babylon, the point of view from which the map was presumably made. Also on the map are the states of Urartu and Assyria, the latter written with the determinative KUR, "land." The cities of Der and Susa and the territory of Bit Yakin are included. The regions, cities, and other geographic features such as the swamp and the water channel are all arranged inside a circle bounded by the waters of the ocean, designated as the "Bitter River" around the entire encircling band. Medieval *mappaemundi* typically show the world encircled by the "ocean sea" (Mare Oceanum) within a spherical world picture; equally, the "ocean river" (Alveus Oceanus) is sometimes shown as dividing the land zones (Woodward 1987, 300). For want of intermediary evidence, one can only note the similar cosmographical elements of the Babylonian world map without drawing conclusions about possible continuities.

Beyond the salt waters surrounding the known cities and lands are large triangular areas (only five survive of the original eight) representing lesser-known faraway places. They could be reached were one prepared to travel 7 *bēru*, but here the ordinary features of the known world are exaggerated or disturbed. One of these distant regions is described as a place where "a winged bird cannot safely complete its journey" (Rev 8′; Horowitz 1988, 150–51). Another is home to horned cattle. A reference to the "Four Corners" of the world (*kibrāt erbetti*) in the last section of the text is followed by the phrase "whose interior no one knows." The inscribed portions of the map are lamentably damaged and incomplete. Even so, because they have a decidedly mythological literary character, with references to heroes and kings such as Sargon, Nur-Dagan of Purushhanda, and Utnapishtim—the only man to survive the great Flood and attain

immortality, well known from the Epic of Gilgamesh (George 2003)—we are for certain in an imagined cosmical landscape.

FIGURE 1.15 Babylonian map of the known world and distant lands. The British Museum, BM 92687. Reproduced with permission.

The question of the map's orientation has been discussed by Eckhard Unger.[50] As already noted, the third-millennium Nuzi map is clearly oriented to the east (IM.KUR, "mountain wind"). On the Babylonian *mappamundi* a mountain is drawn at the top of the circle of the world. From the vantage point of Babylon, the mountain could represent the east. If so, however, then other places are not arranged accordingly; Assyria, for example, is placed below and to the right of Babylon (in fact, it lies to the north), while

Susa, shown at the bottom, should not be in the west (in fact, its location is southeast of Babylon). Altogether, places do not appear to be situated exactly in accordance with any given orientation of the map.

The historical and literary references in the description accompanying the map resonate with the historical and cosmical atmosphere of its iconographic representation of the world. That representation's collection of toponymns indicates a date of composition not before 900, but the extant copy is Late Babylonian and seems to have a Babylonian provenance. The inclusion of Urartu and Bit Yakin points to Neo-Assyrian history. The territory of Bit Yakin, located in the southernmost part of Mesopotamia, was independent of Assyrian rule for a time during the eighth century (721–710) through the political and military efforts of Mardukapla-iddinna II.[51] Urartu, Assyria's northern neighbor, was a frequent target of attack during the ninth and eighth centuries by kings such as Assurnasirpal II (883–859) and Sargon II (722–705). It was very roughly at this juncture, early in the first millennium, that the ideology of Babylon as the new Nippur, the center of the world and linchpin of heaven and netherworld was formed (Maul 1997). In addition to historical references, the map incorporates cosmical features such as the "Bitter River" surrounding the known land, and the triangular "regions" beyond the sea and the limits of empirical knowledge.

## II.5. ITINERARIES FOR PRACTICAL GEOGRAPHY

Noniconographic topographies attested in cuneiform—such as "The Sargon Geography" describing "the totality of the land under heaven" conquered by the "King of the Universe" (Horowitz 1998, 67–95), or the five-tablet compilation entitled "Tintirki (=) Babylon, on Which Fame and Jubilation Are Bestowed"—provide detailed information on lands and regions as well as descriptions of temples, shrines, streets, walls, and rivers. Awareness of great distances and of the diversity of terrain in regions far from the cities of the Mesopotamian heartland is also preserved in the form of itineraries and surveys of the topography of places traversed by trading caravans or military campaigns (Millard 1987, 107–8). But the motivation for recording descriptions of faraway or even local places, or routes and distances between places, seems not to have been to produce a geographic "road map." While these texts are not maps, they do perhaps reveal an affinity with them and with the claims to political, economic, or cosmological power from which they derive. Lands are known and then written about because they are either conquered or traversed for economic or military purposes; or, conversely, they are epitomized as the centers of power and of all creation.[52]

Conquest, the establishment of overland and long-distance commerce, and even the elevation of a certain city to the role of "center" (as was the case first with Nippur then with Babylon), while all quite different phenomena, are nevertheless various manifestations of power relations between rulers (or traders) and the land. The dynamics of power result in the imposition of various forms of order or organization upon the land and its inhabitants. This imposition as confirmation of the exercise of power is the implicit substance of literary and iconographic representations of those conquered or otherwise controlled lands that merit such representation. Economic power had its direct and physical consequences in the creation of various hierarchies of wealth and control over resources. Such economic and political control shaped the land and the landscape; it in turn made possible the building of towns, cities, roads, and watercourses to irrigate fields for further development of economies. Consciousness of these processes is manifest in the geographic texts as well as in mapmaking.

A Larsa-period itinerary, dated by internal criteria to the reign of King Rim-Sin of Larsa (Hallo 1964, 85), a contemporary of Hammurabi of Babylon, seems to describe a historical "forced march" of nearly three months from the city of Larsa to the city of Emar on the Euphrates River in Syria, detailing layovers, delays, and detours. However, such travel was not accompanied by mapmaking, nor evidently did it require any. After all, a journey from point A to point B neither involved nor demanded a process of fixing certain ordered structures upon the landscape; hence, it did not lend itself to Wood's "iconic coding."

The "Sargon Geography," a literary creation preserved in two tablets from the first millennium (one Neo-Assyrian, the other Late Babylonian), enumerates the lands conquered "three times" by the third-millennium ruler Sargon of Akkad and gives their relative sizes. Micellaneous ethnographic information about the peoples of conquered territories is included, such as the comments that the Amorites and the Lullubu "do not know construction," and the people of Karzina "do not know burial," but cremate their dead (Horowitz 1998, 91–92). The boundaries of the lands are defined, and the "circumferences" (*talbātu)* of major land areas measured (Marhaši, Tukriš, Elam, Akkad, Subartu, Amurru, Lullubi, Anšan). Lands beyond the Upper and Lower Seas are named; together with the measured territories they compose "the sum total of all the lands." The literary character of the text makes it difficult to assess the historical geographic claims made about the extent of the empire. In general, the place-names are arranged in sensible geographic contiguities, with most places lying between the Euphrates and the Tigris, or east of the Tigris. What appears ostensibly geographic, however, is really more a declamation of the lands subject to Sargon's power.

## III. The Celestial Landscape

Images of the heavens projected onto the flat surface of a "map" and showing the totality of the starry skies were unknown in the ancient Near East. There was no method by which the arrangement of any celestial objects would be projected onto a flat plane. Stereographic projection requires the notion of sphericity, from which—using mathematical rules—points on a flat surface are plotted to correspond to points on a spherical one, be it earth or heaven. Our evidence argues rather forcibly against the notion that the spherical cosmos had any importance in Babylonian thinking. Thus any representation of stars or star groupings has other purposes.

As represented in Sumerian and Akkadian mythological poetry, heaven (divine AN) was paired with "earth" (divine KI = *erṣetu*), that is, everything that lay under heaven from the surface of the inhabited earth to the underworld, including the subterranean sweetwater (*apsû*) and the land of the dead. As such, AN and KI were the two principal and inseparable parts of physical space. Consistent with this idea of heaven and earth as counterparts, spatial relations were expressed by means of an extension of terrestrial metrology to the celestial. As mentioned above, the units for measuring time as linear distance were the *bēru*, "double-hour" (approximately 10 km), subdivided into 30 UŠ, "degrees" (each approximately 4 minutes of time). Marvin Powell (1987–90, 467) is surely right to explain the relation of terrestrial to celestial measurement as a consequence of the probably archaic tendency to measure long distances on earth by means of the perceived movement of heavenly bodies corresponding to the time taken by humans to travel so far.

In nonscientific contexts the *bēru* was often used simply as a means of denoting great distance, describing either overland or celestial spaces that were manifestly not in fact measured, as in this inscription of King Esarhaddon of Assyria: "Bâzu, a district located afar off, a desert stretch of alkali (lit., salt-earth), a thirsty region: 140 *bēru* of sand, thorn-brush and 'gazelle-mouth' stones, 20 *bēru* of serpents and scorpions, with which the plane (*sic*) was covered (lit., filled) as with ants, 20 *bēru* (through) Mt. Hazû, a mountain of saggilmut-stone, (these stretches) I left behind me as I advanced (thither, i.e., to Bâzu) where, since earliest days no king before me had come."[53]

The mythological tale of Etana, a man who ascended to heaven with an eagle, likewise describes travel in terms of *bēru*, as in the itinerary genre. Etana and the eagle fly 3 *bēru* up into heaven beyond the reach of the "Heaven of (the sky god) Anu," passing through two gates to reach the house of Ištar. As they make their ascent, the land is viewed from above and described as a garden which also has agricultural features like an animal pen and an irrigation ditch. The sea is said to encircle the land, but when they have reached their goal, 3 *bēru* up, land and sea disappear from sight: "[He li]fted him up a third double-hour: Look my friend, the land, what is it [like?]. I am looking, but I do not see the land, and my eyes do not feast on the broad sea" (Horowitz 1998, 56–57, lines 38–41).

In traversing 1 *bēru* (= 30 NINDAN, "rods") overland, therefore, the sun likewise traversed 1 *bēru* (= 30 UŠ, "degrees"), or one-sixth of the sky. Celestial movement—that is, distance in heaven—indicated time. The length-time system was based on an ideal day (UD) reckoned as 12 *bēru*. Powell (1987–90, 467–68) noted that the correspondence between the 12 *bēru* of the day and 360 UŠ on the one hand, and the twelve ideal months of 30 days each and 360 ideal days, on the other, was probably no coincidence. However, as he made clear, the link between geodetic and celestial length-time measure had no influence on the determination of the metrological standard equivalents for the terrestrial unit DANNA/*bēru*, which among other factors was considered to be the length of a field a team of oxen could plow in one day.

Measurement of time by means of celestial distances is seen in connection with a group of stars known as "zenith (*ziqpu*) stars" that "culminated"—that is, crossed the meridian—near to the zenith, around latitude 36° north (Nineveh). A Late Babylonian text (*Textes cunéiformes du Louvre* 6 21) gives a list of successive culminations of a fixed sequence of such stars, beginning and ending with MUL.ŠUDUN, "The Yoke Star" (= Boötes). This list gives the intervals between the *ziqpu* stars in *mana*, "mina," UŠ *ina qaqqari*, "degrees on the ground," and *bēru ina šamê*, "celestial *bēru*." The degrees "on the ground" seem to correspond to degrees of stellar motion. Because the fixed stars rise and set in arcs parallel to the celestial equator, the rising, setting, or culmination of equal arcs between these stars rise, set, or cross the meridian in equal times, and thereby make it possible to reckon the passage of time by means of those intervals, or stellar "distances." The equivalence established between the units for the measurement of stellar distances in this system was 1 mana = 6 UŠ *ina qaqqari* = 10,800 *bēru ina šamê*.[54]

Shorter apparent distances were sometimes designated by the cubit, subdivided into 30 fingers. The cubit had an astronomical application for measuring distances in the heavens between fixed stars and the meridian, for example, or between planets and ecliptical stars, as well as for measuring eclipse magnitude. The equivalence 1 cubit = 24 fingers = 2 UŠ ("degrees") gives us 1 finger = 0;5° and 1° = 12 fingers. The cubit is

used in two of the earliest observations recorded in the *Almagest* (9.7), from years –244 and –236. Ptolemy cites (1) Babylonian eclipse reports, giving time at which eclipse begins, statement of totality, time of mideclipse, and direction and magnitude of greatest obscuration in digits, in the manner of cuneiform eclipse reports, (2) distances in cubits from ecliptical norming stars (Normal stars) at dawn for Mercury, the dates for which are given in the Babylonian calendrical system of lunar months (translated into Macedonian month names) and years in the Seleucid era, and (3) the distance of Saturn in digits from a Normal star in the evening.[55]

In Babylonian astronomy the concerns of celestial measurement had to do either with distances between the moon and fixed stars, or the moon and planets, in observational records, or with what we would call "longitudinal" distances along the ecliptic of planetary or lunar phenomena. In the latter case, however, longitude is not measured, but calculated in degrees of distance within the circle of the zodiac in accordance with algorithms for finding such distances. The *ziqpu* texts mentioned above, in which distances between fixed stars are quantified, also establish spatial relationships in the heavens. Even so, these interests in distances and relations between celestial positions fall within the boundaries of astronomy rather than what we would call star mapping.

### III.1. ASTROLABES

The so-called astrolabes constitute a fundamental corpus of early Babylonian astronomical texts. The earliest exemplar stems from the Middle Assyrian period (the reign of Tiglath-Pileser I, 1115–1077). It is probably already a copy from an earlier, perhaps Old Babylonian source, and the text was still being copied in the Seleucid period (third century or later). The term "astrolabe" is a misnomer insofar as the cuneiform exemplars are not planispheric. However, they do map out fixed stars, constellations, and even planets in various parts of the sky for the twelve months of an ideal year (360 days, i.e., twelve months of 30 days each), either by listing in groups, with the stars of the three roads set alongside one another, or by arranging them in rings in a concentric circular diagrammatic form, three stars per month for a total of thirty-six stars.

The groups of stars are defined by their locations with respect to the horizon, and in a rough sort of distribution into three "roads" (*harrānu*), differentiated by declination.[56] The stars closest to the equator rise in their assigned month in the road of Anu, those to the north in that of Enlil, those to the south in that of Ea. These divisions of the sky, named for the three great cosmic deities, are also widely attested elsewhere, in the astronomical compendium MUL.APIN (discussed below), in prayers, scholia, and other star catalogs. The monthly rising of an astrolabe star represents the important reappearance of the star following its period of invisibility. The reemergence of the star in the sky is a seasonal event, with respect both to its date and its place of rising. The astrolabe text selects thirty-six heliacally rising stars (for fixed stars near to the ecliptic the heliacal rising is the first appearance in the morning following the seasonal period of invisibility when in conjunction with the sun), twelve in each of the "roads."

The question of the purpose of the circular diagram of the astrolabe text arises in the context of celestial mapping. The same elements are presented in the circular diagram as in an alternative list form of the astrolabe. In general, the mapping function of these texts derives from their attention to the association of fixed stars and their "roads," and from the fact that the entire sky over the course of a year is taken into account. As Johannes Koch has pointed out (1989, 120), the circular astrolabe was not an astronomical device, but rather an orientation guide and an aid to remembering which

stars appear in which parts of the sky.

### III.2. PLANISPHERES

There survive two disk-shaped clay tablets with evidence for celestial topography: one is a seventh-century Nineveh library text showing constellations inside a circular arrangement of eight 45-degree segments (Koch 1989), and the other is a Neo-Babylonian tablet from Sippar showing the zenith, or *ziqpu*, stars in a circular arrangement of twelve 30-degree segments (Horowitz and al-Rawi 2001). The former has been dubbed the "planisphere" (K. 8538, King CT 33 10), and it alone provides iconographic representations of constellations. The only features common to both are that they are disk shaped, they divide the circle of the sky into equal parts, and they make use of dots to represent stars.

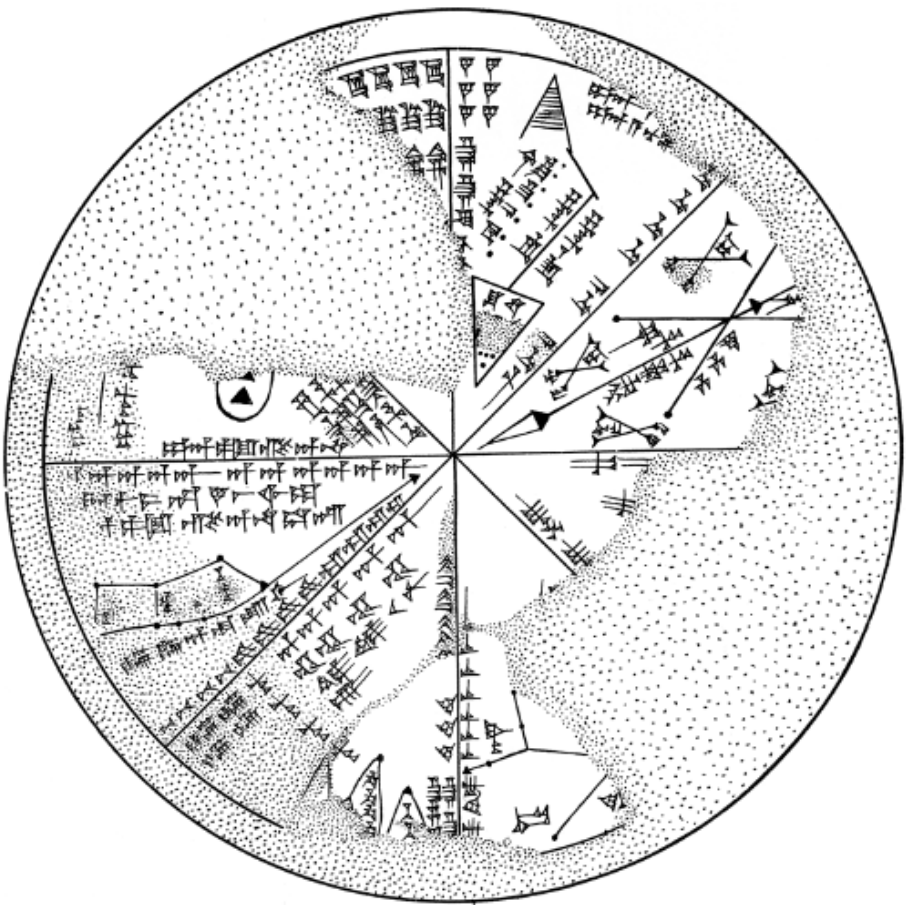


FIGURE 1.16 Redrawing of the seventh-century-BCE Nineveh planisphere, depicting constellations with their names. The British Museum, K. 8538. Reproduced from L. W. King, *Cuneiform Texts from Babylonian Tablets in the British Museum*, pt. 33 (London, 1912), plate 10.

The Nineveh planisphere (fig. 1.16) is slightly rounded on the reverse and inscribed only on the flatter side, or obverse, which has a slight rim or raised edge. It is not truly

comparable to what is today considered a planisphere, a device that shows the sky in the different seasons of the year and different times of the night by the rotation of one disk that represents the horizon against another disk that projects the stars onto a circular plane. The Nineveh planisphere shows "connect the dot"–style figures in six of eight sectors (fig. 1.17). These figures represent constellations and are identified by name on the tablet. Beginning with sector 0, as indicated in the center of the diagram, and running counterclockwise, is the arrow figure inscribed as Ištar and Dumuzi. In his interpretation of the planisphere, Koch reasoned that because Ištar is associated with the Bow Star, Dumuzi must be the Arrow. In sector 1 is an image with two triangular figures, labeled muliku, "The Field," and mul apin, "The Plow," the combination of which makes sense; the Plow is given an epithet, "who goes in front of the stars in the road of Enlil." Sector 2 has no star name preserved. In sector 3, containing an ellipse with two enclosed wedges, is written mulIs lê, "The Jaw of the Bull," and mul MUL, "Pleiades," as well as Sipazianna, "Orion."

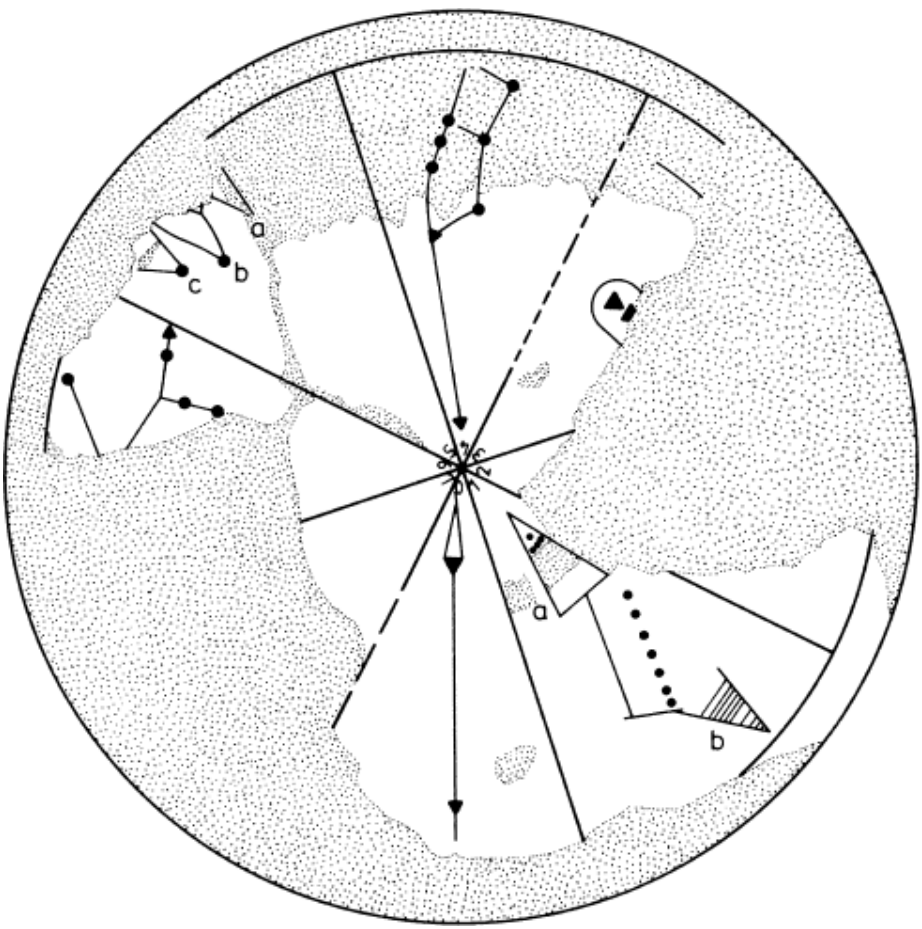



FIGURE 1.17 Reconstructed drawing of the Nineveh planisphere. Reproduced from Johannes Koch, *Neue Untersuchungen zur Topographie des babylonischen Fixsternhimmels* (Wiesbaden: Harrassowitz, 1989), p.112, with permission of the publisher.

Next, sector 4 contains a figure with three dots in a row and a long pointer with a

wedge-shaped tip at the end, pointing directly to the middle of the circle. It gives the name of the twin stars known as "The Twins who stand in front of Orion." They are known from a list of seven divine twins (7 *mâšu*)[57] that includes other sets of twins in the constellation Gemini, namely, MULMAŠ.TAB.BA GAL.GAL (who are the evil Meslamtaea/Nergal and Lugalgirra/Sin) and MULMAŠ.TAB.BA TUR.TUR. Koch has identified these with γ and ε Geminorum. Inscribed in this sector 4 too is the divine name Lātarāk, also a destructive figure, associated with the Asakku demon. Sector 5 mentions Regulus, "The King," and Corvus, "The Crow," written inside one of the small pointed figures. Inside another pointed figure is inscribed the sign BE, whose reading here is uncertain; Koch identifies this latter figure with mulAB.SÍN, "Libra." Finally, in sector 6, a balance figure is inscribed with the name of Libra, written mulGI.GI (= mulZI.BA.AN.NA = *zibānītu*).

The other planispheric text comes from Sippar. It is inscribed on both sides.[58] The obverse of the tablet shows parts of twelve 30-degree segments indicated with straight lines radiating out from a central rosette. The names of *ziqpu* stars and arrangements of dots are preserved in six of the twelve segments. The *ziqpu* star names show that the disk is to be read in a clockwise direction. As labeled in the diagram (fig. 1.18), segment 1 is the "Hand of the Crook," without dots preserved, and "The Twins" (Nabu and Nergal), shown with two dots. Segment 2 is "Crab" (ten dots) and "The Two Stars of the Head of the Lion" (two dots). Segment 3 has "The Four Stars of his Chest" (of the Lion, four dots) and "The Two Stars of his Tail" (two dots). Segment 4 gives "The Single Star of Its Tail" (one dot), "The Frond" (six dots), and "The Harness" (one dot). Segment 5 is "The Yoke" (two dots) and "The Rear Harness" (three dots). Segment 6 shows "The Circle" with a circle of dots. The circular arrangement of the *ziqpu* stars here on the obverse of the disk corresponds to the list of these stars on its reverse. The list there in turn seems to parallel the astrolabes' presentation of stars both in lists and in circular diagrams.

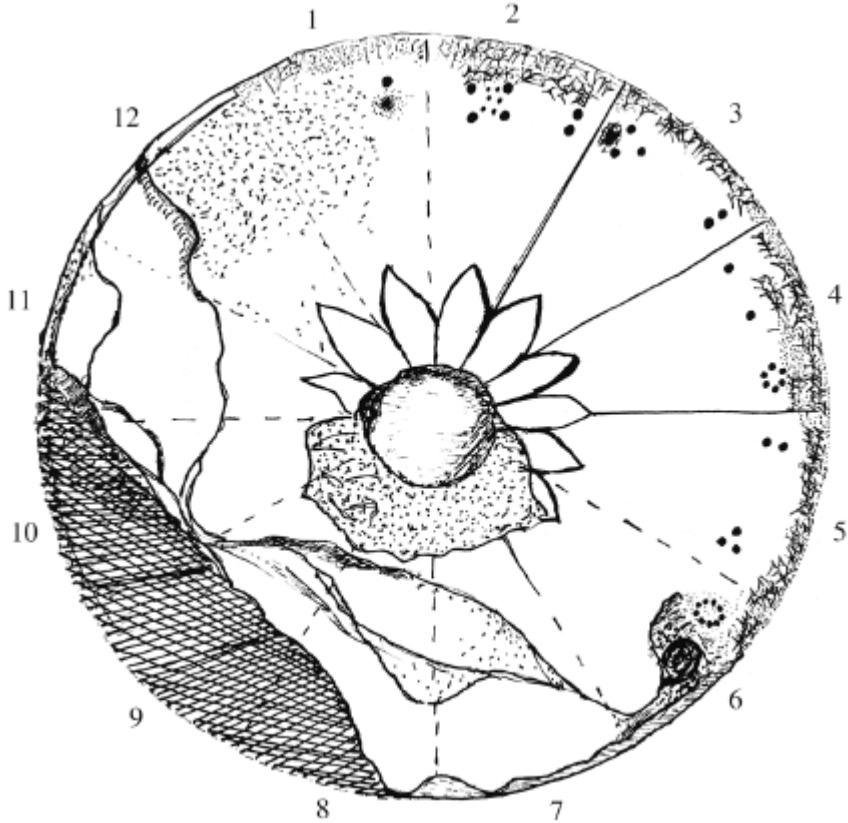



FIGURE 1.18 Redrawing of a *ziqpu* star disk representing the number of stars in a group of constellations. Reproduced from W. Horowitz and F. N. H. al-Rawi, "Tablets from the Sippar Library IX: A *Ziqpu*-Star Planisphere," *Iraq* 63 (2001): 177, with permission of the publisher.

**III.3. ITINERARY FOR PRACTICAL ASTRONOMY**

An important astronomical compendium of the early first millennium is the two-tablet series entitled MUL.APIN, "The Plow Star" (Hunger and Pingree 1989). Like the geographic itineraries, its function is to map major celestial objects, their locations on certain "roads," and their relative positions toward a kind of practical astronomy. By contrast to the geographic itineraries, however, interest in describing the landscape of the sky was not related to acts of political, economic, or military power. At the same time, the calendrical concerns underlying many of the astronomical subjects of interest in MUL.APIN demonstrate that its motivation was not merely disinterested description of "natural phenomena," but rather an understanding of the environment together with some control of it. Further confirmation that a desire for understanding and control was at stake in the preparation of this astronomical compendium emerges from the sections of the text that provide rules for prediction relevant to a fixed calendar, such as the intercalation rules established by coordinating the date of the heliacal rising of the Pleiades with the first visibility of the moon, or indeed, the intercalation rule given with reference to the appearance of Sirius (Tablet II.i 22–24.). MUL.APIN deals with schemata and its calendrical underpinnings are schematic (the year of twelve 30-day months), as are its catalogs of stellar risings and settings, as well as its intercalation schemes. It presents a practical astronomy useful for celestial divination, whose general attitude

about heavenly phenomena it shared, namely, that these were significant to know and understand: the gods had "produced" the appearances to signal events in the future, and the knowledge gained was to be used by human beings to enhance their security in the world. This belief made it desirable to identify periodic phenomena and to devise convenient ways of predicting them, such as by numerical schemes.[59]

About sixty-six stars and constellations (including the five planets) are classified in this text in accordance with the arcs or pathways in the sky—termed "roads," as mentioned above—which describe their risings and settings. Three such "roads" are demarcated, and named for the gods Anu, Enlil, and Ea. In modern terms, the Road of Anu is reckoned as the arc over the horizon, the "cattle pen," where stars relatively close to the celestial equator, approximately 15 degrees ± declination are seen to rise; the Road of Enlil is to the north and actually includes the circumpolar stars; the Road of Ea is to the south. The Plow Star's celestial itinerary designates the Road of Enlil as the head of the cattle pen, the Road of Ea as the foot. Given the knowledge that the fixed stars rise and set over fixed points along the horizon with seasonal regularity, the Plow Star also lists the simultaneous rising and setting of constellations and fixed stars in the three roads, season by season. Moreover, because it was understood that the planets do not appear in the same place with respect to the eastern or western horizons at their first and last visibilities, a rough estimate of the intervals of visibility and invisibility of planets was made. Another feature of the visible heaven included in MUL.APIN is a catalog of stars known as *ziqpus*, which are seen to cross the meridian and thereby are useful for telling time at night (Hunger and Pingree 1999, 84–90). MUL.APIN makes an association between twelve *ziqpu*'s crossing the meridian before sunrise in midmonth and the heliacal risings of certain constellations.[60]

Without representing the observable features of the night sky iconographically, MUL.APIN described and presented in a systematic fashion the chief routes taken by stars and planets across the celestial landscape. As an "itinerary" of the heavenly region in the form of a practical astronomy, MUL.APIN is functionally parallel to the itineraries on the ground in the form of practical geographies.

## IV. Conclusion

Although cuneiform maps may not be forerunners from which later Western maps originate, they share characteristics with other cartographic traditions in their graphic imaging of territorial, social, and cosmological space. Cuneiform texts provide several varieties of evidence for the ancient Mesopotamian efforts to express order by describing, delimiting, and measuring the heaven and earth of their experience, producing house, temple, plot, and field plans, city maps, and, with respect to the celestial landscape, diagrammatic depictions of stars. Various orders of power are implicit in the expression of these aspects of order in the environment. Administrative and economic powers support, or even require, the making of maps, as well as determining overtly the topographies that maps depict.

Where once such maps would not have been admitted within a general history of cartography, a new view of the meaning of the map can embrace them. The historiography of maps and cartography has emerged from criticisms similar in nature to those made against the modernist or presentist historiography of science, namely, that in reifying science or sciences such as cartography, false evolutionary histories are liable to be constructed. Some originating point is identified, such as the origins of science in

Greece, or of mapmaking in Babylonia, from which a continuous history may be written from a presentist perspective, a tale of a discipline's inexorable progress from its originating moment to the present. Critical cartographic history, however, has laid aside such ideas, and we no longer look to (in the words of Denis Wood), "a hero saga involving such men as Eratosthenes, Ptolemy, Mercator, and the Cassinis, that tracked cartographic progress from humble origins in Mesopotamia to the putative accomplishments of the Greeks and Romans" (Wood 1997, 549).

By no means do all ancient Near Eastern maps display metrological finesse or even the use of measurement, though some characteristically do, such as the agrarian field and urban plot cadastral surveys. Concern for orientation is attested in a number of maps, but not always in the same way, although with a tendency toward an oblique orientation northwest to southeast. Ancient Near Eastern maps may not have invariably been meant as exact or direct replications of territory, but there can be little doubt that they distinctively reflect the conceptual terrain of their social community and culture at large. The maps of buildings and fields focus on the urban and agricultural environment, matters of critical importance to whatever political and economic powers prevailed.

The maps of cities with their waterways and surrounding physical landscape combine cartography of sacred space, seen in the temple plans, with that of economic space, seen in the field surveys. The cities of Nippur and Babylon had a religious and cosmological function as well as a political and economic one. In the periods of their supremacy each was viewed as the center of the universe, as the meeting ground between heaven and the netherworld. The map of the principal temple in Babylon, E-sagil, which was the earthly abode of the national deity Marduk, represents the terrestrial counterpart to the celestial residence of the great god Enlil, designed, figuratively speaking, on the blueprint of the cosmic subterranean sweet watery region of the Apsû (*Enūma Eliš* IV 143–46).

The Babylonian world map is an attempt to encompass the totality of the earth's surface iconographically: land, ocean, mountain, swamp, and distant uncharted "regions." This said, it represents more of an understanding of what the world is from the viewpoint of historical imagination than an image of its topography against a measured framework. It offers a selective account of the relationship of Babylon to other places, including those that were at the furthest reach of knowledge.

The diversity of cultures that have sought to preserve their maps, putting them on clay, papyrus, parchment, and other writing media, points to a near universality of making maps in human culture. Cognitive psychologists claim that we come into our physical world mentally equipped to perceive and describe space and spatial relationships.[61] The linguistic act of spatial description is perhaps a protomapmaking function of our very desire and attempt to place ourselves in relation to the physical world. By extension, we should not doubt that mapmaking too, in all its historical subjectivity, is a universal feature of human culture. The interest of the cuneiform maps lies in their rich articulation of such a feature, uniquely shaped by the particular social norms and forces that emerged and changed within ancient Mesopotamian history.

## ABBREVIATIONS

| | |
|---|---|
| AO | Antiquités Orientales |
| *CAD* | *The Assyrian Dictionary of the Oriental* |

| | |
|---|---|
| | *Institute of the University of Chicago* |
| CT | Cuneiform Texts from Babylonian Tablets |
| K | Kuyunjik Catalogue, British Museum siglum |

# TWO

## From Topography to Cosmos: Ancient Egypt's Multiple Maps

**David O'Connor**

### I. Introduction

Modern societies are inundated with maps, rendered strictly to scale and often very detailed. They range in subject from local street maps to the entire globe—where already the conflict between representation and topographical accuracy results in a significant visual distortion. Such maps are each "a highly refined spatial diagram depending on histories of development of such techniques as surveying" (Quirke 2003, 171). Among the many functions of maps, two are perhaps especially important. Maps can provide detailed guides enabling individuals and groups to "find their way," if necessary in a highly detailed mode, over expanses of terrain or water, be they small or very large. Maps are also fundamental records of property and ownership, at many scales, depicting states and empires down to individual residences and plots of land. Ancient societies were always interested in this first function—"finding the way"—and often the second: who owned what; what yield, income or tax could (or should) specific plots, regions, provinces, or states deliver; who was responsible for maintenance, improvement, or sometimes destruction, and on what scale and with what topographical specificity. In the words of one early second-millennium pharaoh referring to his Nubian opponents to the south of Egypt (fig. 2.1): "I have . . . gone to their wells, killed their cattle, cut down their grain, set fire to it," all with reference to a specific region, even if not defined here. In this same context, the significance of a specific geographic interface, the frontier that divides and defends spatially defined polities and cultural realms, is reiterated. The same king states: "As for any successor of mine who shall maintain this border [with the Nubians] which my majesty has made, he is my son, born to my majesty. The true son [i.e., successor] is he who champions his father, who guards the border of his begetter. . . . Now my majesty has had an image made of my majesty, at this border which my majesty has made, in order that you maintain it, in order that you [my successors] fight for it!" (Lichtheim 2006a, 119–20).

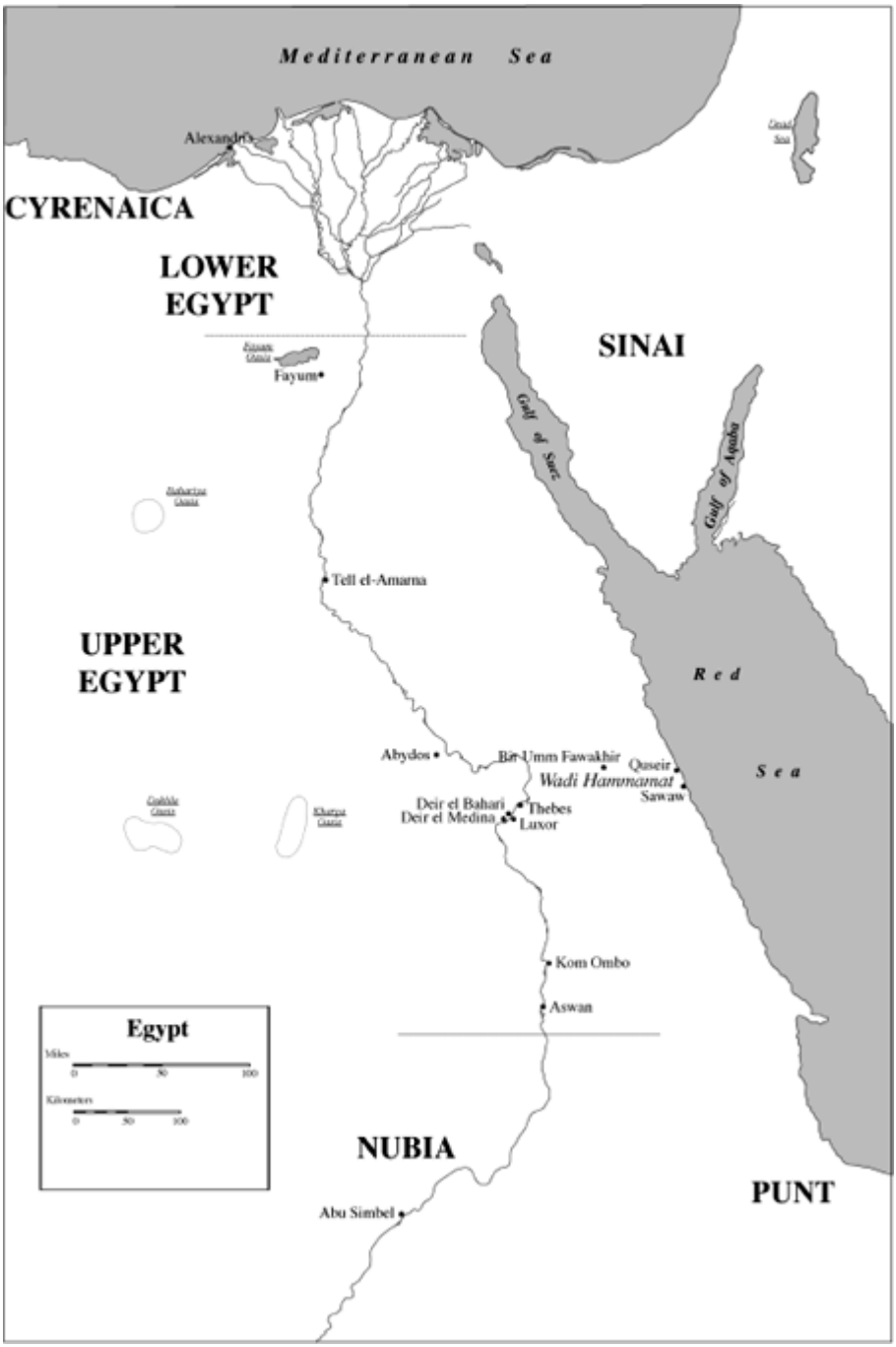



FIGURE 2.1 Map of Egypt and northeast Africa: regions and sites referenced in the text. Original drawing.

Despite such shared interests between past and present, ancient societies are almost embarrassingly notorious for their seeming lack of interest in detailed maps drawn to scale at almost any level. Egypt provides a particularly interesting context for questions

relevant to this phenomenon. It is natural to enquire first whether Egyptians *did* possibly produce equivalents to modern maps, but examples have not yet been discovered. This is no idle question, because excavation in Egypt has typically focused on temples and tombs. Both contexts are rich in art and texts, and—in the case of tombs—artifacts of both specifically mortuary and "daily life" significance. However, the functions and "decorum"[1] of such contexts would militate against the depiction or inclusion of topographically accurate maps or plans in our modern sense.

In this connection it is noteworthy that the examples of Egyptian maps and plans closest to modern concepts have come from settlement sites rather than temples or tombs, and settlement site archaeology is rarely carried out in Egypt. These items are better described as "quasi maps" (or plans), but they nevertheless show an interest in topographical or constructional detail similar to that of early modern maps and plans, and sometimes this is provided with specific dimensions (length and breadth), although seemingly never rendered to scale. However, even in settlement sites the survival of such material is problematic, especially for examples drawn on papyrus, a favorite and durable material for everyday use, but very vulnerable over the millennia to decay, not to mention damage by humans, insects, and water. In any event, relatively accurate maps and plans would be of interest only to specialist groups and would not have been widespread for the most part. All the most detailed quasi maps and quasi plans so far known from ancient Egypt definitely or probably come from a quite unusual place, occupied by an unusual community.

Deir el Medina—today a fully excavated and relatively well preserved site—is one such instance. It was a village built to house the workers of the royal tombs, and their families, throughout the second half of the second millennium. It is located at Western Thebes (opposite the modern town of Luxor), where almost all pharaohs of the New Kingdom (see table 2.1) were buried in usually large, tunnel-like and richly decorated rock-cut tombs.[2] The artisans housed in this village were responsible for cutting out the tombs, according to prescribed plans and elevations, and covering their walls and ceilings with seemingly endless programs of scenes and texts on painted plaster or in painted relief. Accordingly, the community's internal structure was quite complex. It included scribes involved in administration, record keeping, and (to some degree) creative tasks, as well as foremen and draftsmen, all no doubt literate, as well as stonemasons, gypsum makers, and sculptors. Moreover, the artisans' and scribes' activities were not confined to the royal tombs alone; from time to time, they might work on other state monuments or participate in working parties sent to recover desirable stones for architectural or sculptural use from the granite quarries of Aswan or from the graywacke and other quarries of the eastern desert, especially along the Wadi Hammamat. As we shall see, these interests involved, on the one hand, the production of relatively detailed plans (with some details in elevation) of either the projected or completed tombs of specific pharaohs and, on the other, the creation of at least one map (and implicitly others) which, while not to scale, depicted in considerable topographical detail a stretch of the Wadi Hammamat approximately 12.25 km long. While this surviving map—the so-called Turin papyrus map—manifestly lacks a consistent scale, a recent study notes that its scale "appears to only vary between 50 and 100 m for each 1 cm on the original scroll, and this is perhaps better than might be expected for this earliest example of cartography."[3]

Table 2.1. Chronological Table, Including Rulers Mentioned in the Text

| | |
|---|---|
| MIDDLE KINGDOM: | |
| 12th Dynasty | ca. 1938–1755 BCE |
| 13th Dynasty | ca. 1755–1630 |
| SECOND INTERMEDIATE PERIOD: | |
| 14th, 15th, 16th Dynasties | ca. 1630–1520 |
| 17th Dynasty | ca. 1630–1540 |
| NEW KINGDOM: | |
| 18th Dynasty | ca. 1539–1292 |
| *Hatshepsut* | (ca. 1473–1458) |
| *Akhenaten* | (ca. 1353–1336) |
| 19th Dynasty | ca. 1292–1190 |
| *Seti I* | (ca. 1290–1279) |
| *Ramesses II* | (ca. 1279–1213) |
| *Seti II* | (ca. 1204–1198) |
| 20th Dynasty | ca. 1190–1075 |
| *Ramesses IV* | (ca. 1156–1150) |
| *Ramesses V* | (ca. 1150–1145) |
| *Ramesses VI* | (ca. 1145–1137) |
| THIRD INTERMEDIATE PERIOD: | |
| 21st–25th Dynasties | ca. 1075–715 |
| LATE PERIOD: | |
| 25th–29th Dynasties | ca. 715–380 |
| 30th Dynasty | 380–343 |
| Second Persian Period | 343–332 |
| GRECO-ROMAN PERIOD: | |
| Macedonian Period | 332–305 |
| *Alexander the Great* | (332–323) |
| Ptolemaic and Roman Periods | 305 BCE–CE 395 |
| *Hadrian* | (117–138 CE) |

## II. Maplike Aspects of Temple Art

Artisans and scribes at Deir el Medina and elsewhere would not be the only sector of society likely to be interested in cartographic representations akin in significant ways to our modern concept of a map. There was no doubt the same interest among the upper echelons of Egypt's administrative and military classes. However, the remains of their offices, libraries, and archives have rarely been located and excavated except, significantly, at Tell el Amarna, which was built and occupied for a brief period as the royal capital of the monotheistic king Akhenaten (ca. 1353–1336). Even though its administrative sector has been located and excavated, unfortunately, it was nearly cleaned out when the town was abandoned, and almost nothing of its presumably once abundant papyrus archive survives. Ironically, what has survived is a dump of clay

tablets, letters written in the cuneiform script and in a version of Babylonian—the lingua franca of the day—from foreign courts throughout the Levant, the Near East, and Anatolia. With their content no doubt translated into Egyptian and transferred onto papyrus, these unwieldy originals were then discarded rather than moved—to become a treasure trove for historians today, though also an indication of how much priceless data (some perhaps topographical) was once produced at the upper levels of Egyptian civilization but survives, or at least is discovered, so rarely.[4]

That such high-level archives might have included significant cartographic components—perhaps similar to the Wadi Hammamat map from Deir el Medina but covering much more extensive territories—is indicated by a few highly unusual representations surviving in the art of ancient Egyptian temples. Although controlled by the somewhat rigid, nonrealistic conventions of Egyptian art (Robins 1997, chap. 1) and by the particular kind of decorum operative within temple contexts, these representations appear likely to relate to more maplike ones on papyrus that were part of official archives. Let us consider two instances.

The first and most striking comprises several versions of the same event from temples of Ramesses II (ca. 1279–1213), a seemingly massive clash between Egyptian forces and a Hittite-led coalition in the vicinity of Kadesh, an ancient fortified town in Syria (in Ramesses's day actually identified as "Kadesh the Old"). The archaeological site and its surrounding terrain are still observable and provide a basic cartographic structure to the representations, which vary significantly in detail.[5] Each representation combines topography and events distributed over time in a complex and dynamically stimulating way, but their organization is structured around a hieroglyph-like rendering of the fortified city of Kadesh, flanked on three sides by the Orontes River and a tributary stream flowing into it. In the representation in Ramesses's temple at Abu Simbel, for example (fig. 2.2), the lower registers depict his camp in the vicinity of Kadesh and involve two events. Prior to the battle he interrogates captured Hittites, and subsequently he addresses his officers. The camp is also shown under attack by Hittite forces the next (?) day, the day of the battle itself, while beyond, a support force of Egyptian troops arrives to help in achieving victory for Egypt. In the registers above, Kadesh and its flanking streams are placed close to the center. On the left, Ramesses charges the Hittites and their allies (he was almost cut off, a detail *not* rendered in the reliefs, although described in the accompanying texts); some are displayed as corpses in the river, although one vignette shows the "Prince of Aleppo" being saved from a watery grave (elsewhere he is shown upended so as to drain the water suffocating his body).[6] To the right, further Egyptian troops arrive after the battle and join in rounding up the prisoners and counting the enemy dead; here Ramesses, standing in his chariot, receives a report on the numbers involved.

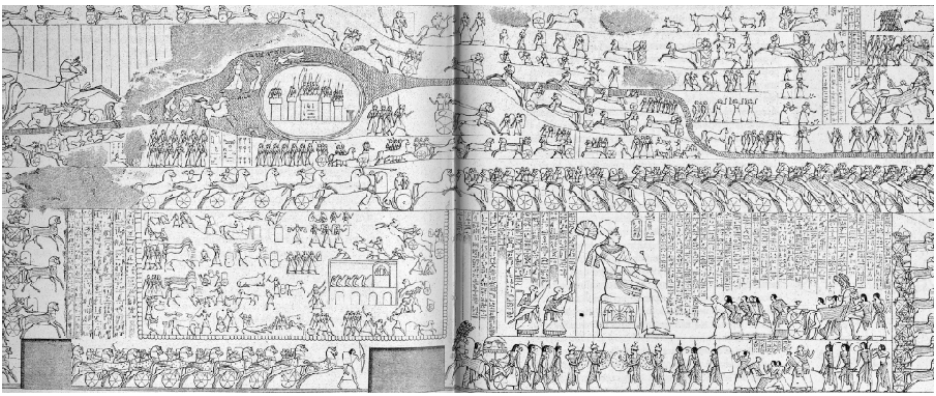


FIGURE 2.2 The Battle of Kadesh in Abu Simbel Temple. Reproduced from James Breasted, *The Battle of Kadesh: A Study in the Earliest Known Military Strategy* (Chicago: University of Chicago Press, 1903), pl. VI.

Unlike his superheroic proportions elsewhere, the scale on which Ramesses is represented in this last instance is surprisingly miniaturized, and even the counterpoised image of him charging into battle is smaller scale than that of him enthroned as pharaoh in the lower register. These modulations of kingly scale reinforce the maplike character of the representation, while the proportions of the totality of the relevant upper registers (a height-to-length ratio of 1:7.3) are reminiscent of the long, narrow roll of papyrus on which maps such as the Wadi Hammamat example from Deir el Medina (discussed further below) would be recorded. The latter's papyrus roll appears to have had an approximate height-to-length ratio of 1:6.9 so far as the *surviving* portion is concerned; its original length is unknown (Harrell and Brown 1992, 83). To be sure, the two items are on very different scales, with the relevant Abu Simbel registers measuring 2.30 × 17.5 m and the papyrus approximately 0.41 by 2.82 m. Nevertheless, the basic topographical structure of the Abu Simbel representation could be envisaged as "scaled up" from a much smaller original representation on a papyrus roll.

The second representation in the art of Egyptian temples that we should consider is in fact the earlier of the two, a unique example displayed on a section of the walls of the temple built by the female pharaoh Hatshepsut (ca. 1473–1458). Its depiction of the sea route to the land of Punt, and of Punt itself, is less reminiscent of a papyrus format, although it is notable that the individual registers featuring the land of Punt are each—in the normal way—long and narrow like a papyrus; on average their height-to-length ratio is 1:8.5.[7] A twice-repeated strip of water filled with carefully delineated fish and other aquatic creatures (all typical of the Red Sea) represents the route along the sea's eastern shore followed by a seaborne trading expedition sent to Punt by Hatshepsut; this route originated at ancient Sawaw, near modern Quseir. Moreover, Kenneth Kitchen (1971) has demonstrated how these pictorial representations correspond to a sailing route along the eastern Red Sea shore, with various landfalls (not indicated in the representation) matching modern or recent ones. Indeed, in all likelihood there was an ancient itinerary listing the names of the relevant places, although as yet no specific such list has been identified among the many New Kingdom and later lists relating to African places and peoples contacted by Egypt (O'Connor 1982). In addition, Kitchen's analysis (2005, 8) indicated that during the New Kingdom Punt lay in part in the general vicinity of modern Port Sudan, although later the name may have shifted to more southerly, but still coastal, regions.

As for the representation of Punt itself, it occupies an entire wall and is arranged as a series of horizontal registers (fig. 2.3). The two lowest depict productive interaction between the Egyptian expedition and the "ruler of Punt," his family, and his people. In each case, a further water strip emblematic of the Red Sea is included in order to indicate that Punt encompassed regions actually on, or adjacent to, the seacoast. Above, four registers depict an Egypto-Puntite expedition traversing wooded regions, gathering *'ntyw* incense (the most desired Puntite product) and the dark-hued "ebony" wood of the region, as well as exotic animals and other items. To find an extensive wooded landscape represented is quite unusual (in apparently hilly terrain, since sources sometimes refer to the "terraces" of Punt); more generally the depiction is full of unusual details and a seeming freshness of observation, such as the beehive-shaped huts—mounted on stilts and accessed by ladders—of the Puntites and others. As Stevenson Smith remarked (1965, 137), this "is not one of the usual generalized representations, but portrays a specific and remarkable event observed in a foreign land upon which the artist has lavished considerable detail, to emphasize its exotic character." In fact, the maplike representation may be even more complex than is usually recognized, because the uppermost two registers include details about human types and specific fauna (giraffe and rhinoceros) indicating that they may cover savannah lands east of the hilly land of Punt, extending as far as the Nile (not depicted) and including Nubian regions such as Irem rather than just Puntite ones (O'Connor 1982, 934–40). If so, the map underlying the depiction would cover a relatively vast expanse, across varied terrain, peoples, flora, and fauna, from the Red Sea shore almost as far as the Nubian Nile. Conceivably, the representation was based upon more specifically maplike records produced by the expedition in question; it may have penetrated more deeply than the earlier ones extending back to the later third millennium.

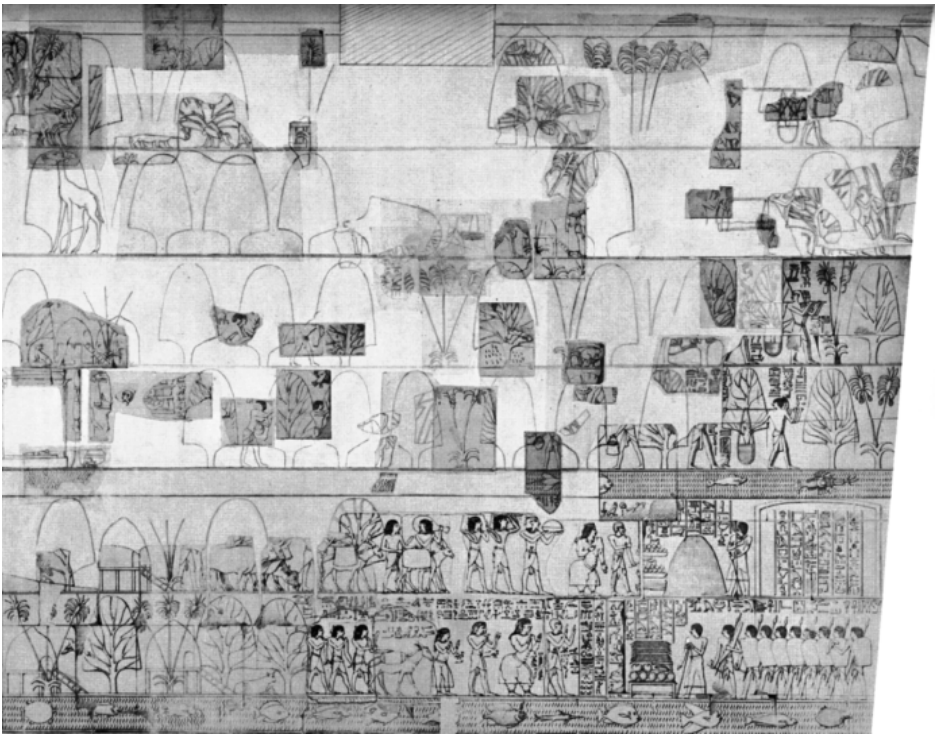


FIGURE 2.3 The Land of Punt (and Nubian Regions?) in the temple of Hatshepsut at Deir el Bahari. Reproduced from W. S. Smith, "The Land of Punt," *Journal of the American Research Center in Egypt* 1 (1962): 61. Reproduced by permission of the American Research Center in Egypt, Inc. (ARCE).

## III. A "World Map" of Seti I

At times temple art was capable of producing a version of a "world map," at least insofar as the extent of Egyptian knowledge stretched. In particular, during the New Kingdom and later (but with earlier origins), temple art often featured lists—which could be very long—of the names of peoples, regions, places, and towns or other settlements located in Nubia; Punt and contiguous regions; "Libya" (primarily Cyrenaica, although itineraries also extended along desert routes); the Levant, Near East, and Anatolia; and sometimes the Aegean, including places on the Greek mainland and Crete. In art—in both temple and in some instances mortuary contexts like depictions of an enthroned ruler on a dais embellished with such a list—the list's individual icons take on a dynamic character. The name of each place or people is written in hieroglyphs and set within an oval frame provided with external protrusions indicating bastions. These thus represent a fortified city wall irrespective of whether an urbanized or nonurbanized people, a state or a village, is actually being indicated; rather, the walled enclosure is emblematic of any entity occupied or utilized by humans. The oval itself is typically topped by the head and torso of a foreign male, usually with his arms bound behind his back, at the elbows, to signify submission to Egypt; details of the facial features, hair treatment, and other attributes are always alien and sometimes differentiated with reference to the specific ethnocultural group named.

Such toponymic lists have been much discussed. Often, especially in the case of

peoples and places in Africa including "Libya," most names cannot be matched with specific areas or sites known today. By contrast, many places named in the Near Eastern and even Aegean segments *can* be identified. Indeed, the patterns they form support Donald Redford's theory that to a significant extent (although not exclusively) such lists represent "itineraries," that is, places distributed along land and sea routes traversed by Egyptian couriers, trading expeditions, and military contingents.[8] Normally such lists would be maintained on papyrus in the appropriate offices of the civil and military establishments, although perhaps without the emblematic embellishments seen on temple walls. Even though the point is expressed in ironic and satirical terms, one literary genre actually makes it clear that the scribes with this responsibility were expected to have a detailed knowledge of such places and the conditions relevant to them (Wente 1990, 106–10). It could be surmised that, in addition to simple lists, annotated versions (incorporating distances, facilities, and other applicable circumstances) were kept too; perhaps even maplike representations of places distributed through specific landscapes were produced (comparable to the partial map of the Wadi Hammamat discussed below). The fact that any such representation has yet to be found is no surprise: as we have already noted, so little such archival material in general has surfaced outside exceptionally well preserved and carefully excavated sites like Deir el Medina.

In principle, archivally maintained lists of toponyms, as well as quasi maps, could be organized in the form of a world map as envisioned by the Egyptians. The possibility is reinforced by versions of just such maps on temple walls, where lists of this type were integrated into larger compositions—structured according to the specific conventions and decorum of temple art—amplifying the concept of a world map for ideological rather than propagandistic reasons. Even on external wall faces, there was limited access to these scenes, because temples were set in walled enclosures to which entry was closely controlled. The display of such world maps relates to one dimension of the multiple meanings expressed by New Kingdom and later temples. These temples were structured and decorated not only to accommodate or depict ritual, but also to establish parallelism with the order of the world, and ultimately with that of the entire cosmos of which the world was a part.

In the New Kingdom, the custom was to display scenes of cult and royal ceremonial on the wall faces of roofed and enclosed areas, whereas royal domination of foreign lands and peoples, and victories over them, were depicted on the walls of courtyards and the external faces of temples and their "pylons" (two-towered entryways). These choices had multiple significance. The pattern described represented the "world order," with Egypt central to the world in general and dominating it, much as the entire cosmos was maintained by deities exercising their coercive power over the forces of chaos and disorder operative within the "other world." Related to this pattern was the concept that both world and cosmic order, brought into being at the time of creation, were in effect repeatedly and endlessly re-created or re-born at certain specific moments, such as the return of the sun to the sky every twelve hours (manifesting the sun god as ruler of the universe). The king's ritual, his government, and his military operations against foreign foes—all depicted in temple art—were an essential part of these processes. Last but not least, temples, as well as the divine beings who vouchsafed to enter into the cult statues there, were ritually protected against penetration by destructive and chaotic supernatural forces; thus, scenes of the king defeating or dominating foreigners were material manifestations of the apotropaic dimension of a temple. World maps, incorporated into

temple programs of art and text, were especially evocative of these varied but interrelated ideas. Hence, they tended to be displayed around major entryways into the temple in order to indicate their particularly powerful manifestation both of apotropaic protection—doorways and gateways being most susceptible to harmful penetration—and of the world and cosmic order that the temple as a whole signified.

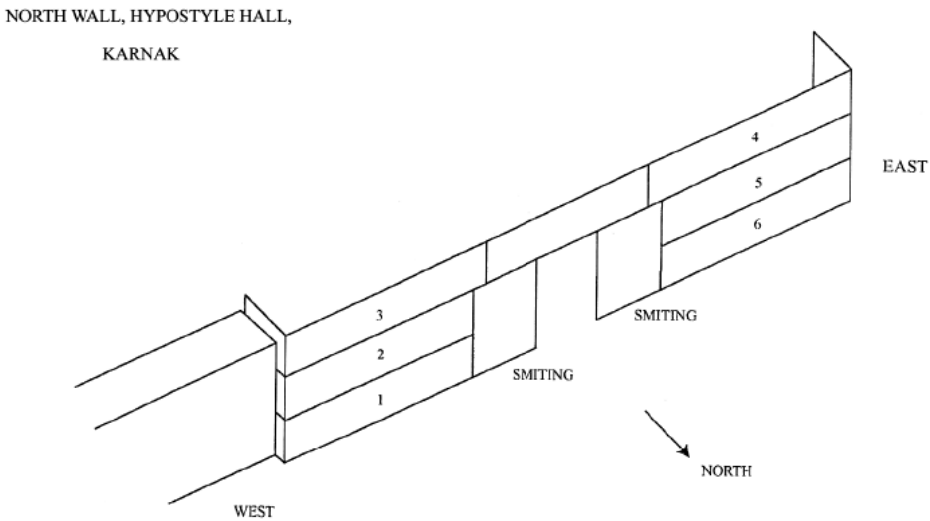



FIGURE 2.4 The world map of Seti I at Karnak: diagrammatic representation. Drawing by David O'Connor and Judith Shirley.

One example of the integration of toponymic lists into larger compositions that in their totality represent both maplike and more dynamic elements of a world map proves particularly revealing. Immense and once vividly colorful, this composition (fig. 2.4) covers the external face of the northern wall of the huge hypostyle hall of the Karnak temple in Thebes, modern Luxor (Heinz 2001, 242–51). Featuring Seti I (ca. 1290–1279), it incorporates various elements (fig. 2.5): traditional "smiting" scenes of the king with upraised weapon dominating, or perhaps preparing to execute, a cluster of foreign foes reduced to paralysis by terror; toponymic lists of the type described above; and actual scenes of conflict between the king, scaled up into a superhero, against various foreign peoples, lands, and even specific cities. The whole composition frames a major entryway into the temple (once sealed off by massive wooden doors encased in metal) with reference to its apotropaic signification. Similarly apotropaic are the smiting scenes adjacent to the entryway, but the incorporation of toponymic lists into these scenes sets up a complex set of relationships that turns the entire north wall face (occupying over 1,000 sq m) into an elaborate version of an Egyptian world map.

The smiting scenes include the imperial god Amun-Re both presenting the king with a sword (emblematic of his divinely ordained power over foreigners) and simultaneously leading to the king a topographical list—tethered by a rope—that comprises a traditional roster of the foreign lands and peoples constituting the world as seen by Egypt. Below, however, representations of a personified Thebes (east) and of Dedwen, a southern god (west), similarly lead topographical lists (each covering the entire world) which are to some extent more up to date and contemporary in content. Moreover, between them these figures combine the concepts of north and east (Thebes) and south and west

(Dedwen), in other words, the four cardinal points expressive of the totality of the king's domain over the entire known world.

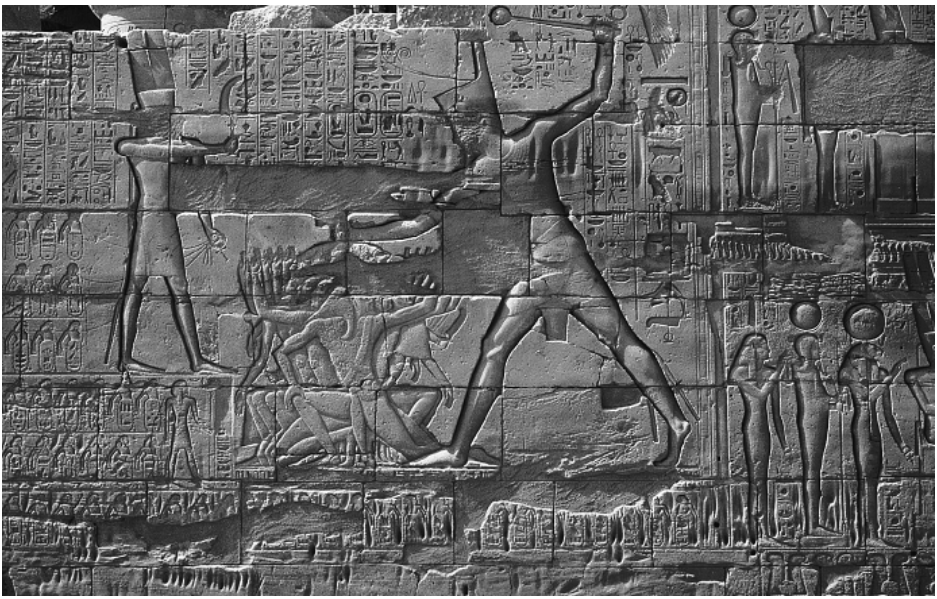


FIGURE 2.5 Seti I smites his foes: relief at Karnak. Note lists of personified country, place, and tribal names. Temple of Amun, Karnak, Thebes. Egypt. Photo credit: Werner Forman/Art Resource, NY.

In addition, the lists associated with the smiting scenes relate to a world map expressed in more dynamic visual terms, namely, the several registers that depict Seti's victories and fill the rest of the wall space (fig. 2.6). These are in part historical events, and in part fictitious in order to complete the map and its meaning. Thus, registers 1 and 2 relate to peoples and regions immediately east of Egypt, register 3 perhaps to a southern region, and register 5 to the Libyans located to the west; finally registers 4 and 6 refer to more remote areas, far to the north. Consequently, the depictions not only cover in pictorial form a range of foreign regions similar to that found in the topographical lists, but also, like the lists, are structured to express totality by emphasizing the cardinal points—east, south, west, and north. Moreover, the depicted regions and peoples consistently represent an ever-increasing actual distance *from* Egypt, as if to articulate the ever-expanding spread of Egyptian power and authority, embodied by Seti, over a vast region. Hence, the topographical lists and the scenes of royal victory compose an interrelated frame, or even an unfolding circular process, central to which are the two figures of the smiting king: he thus is both central to the entire world and completely overshadows it.

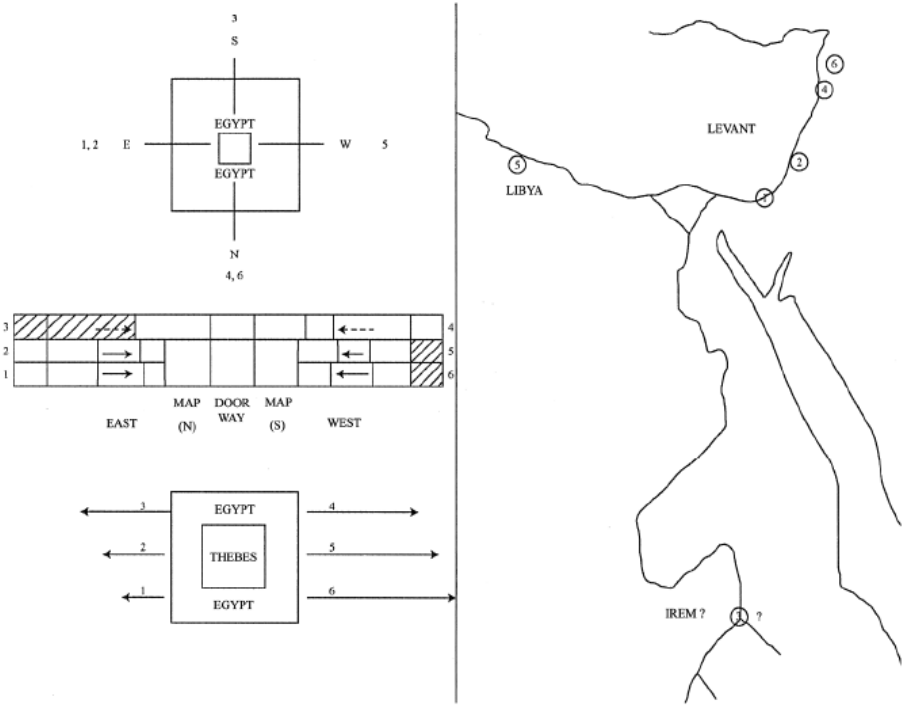



FIGURE 2.6 Geographic aspects of the world map of Seti I at Karnak. Drawing by David O'Connor and Judith Shirley.

## IV. "The Oldest Known Geographic Map in the World" and Related Material

A map partially preserved in the form of fifteen fragments of papyrus in the Egyptian Museum in Turin, Italy,[9] is one for which the maplike representations described above form a potentially significant context; it is logical to consider it next, therefore, along with some related material. This Turin papyrus map[10] is of course at a much smaller scale than the representations in temples, and preserved on a far more fragile surface. Even so, it may be prototypical for other "maps" drawn on papyrus and based, directly or indirectly, on firsthand observation of the relevant topography; such "maps" could have provided visual information for the designers and artisans who created the large-scale depictions.

It is important to be aware of some related material before turning to the map itself in detail. A plausible case has been made that the map was drawn by Amennakhte, who was once a senior "draftsman" (artist) at Deir el Medina (fig. 2.7) and was eventually promoted to be one of the two chief "scribes," or administrators with oversight of the artisans there and their official functions and support.[11] Amennakhte was probably responsible for another initiative related to cartography, namely, a careful rendering of the tomb of king Ramesses IV (ca. 1156–1150),[12] one of the several kings (from Seti II to Ramesses VI) whom he served. Naturally, as a draftsman and later scribe, he was intimately familiar with this tomb (fig. 2.8 and plate 2). Other plans of royal tombs exist and are comparable to maps in their attempts to define built features in plan form. Indeed, one such plan (Turin Papyrus 1923) concerned another royal tomb—intended for Ramesses V, taken over for Ramesses VI—which would have been constructed under

Amennakhte's partial direction, although he was not responsible for this particular plan.

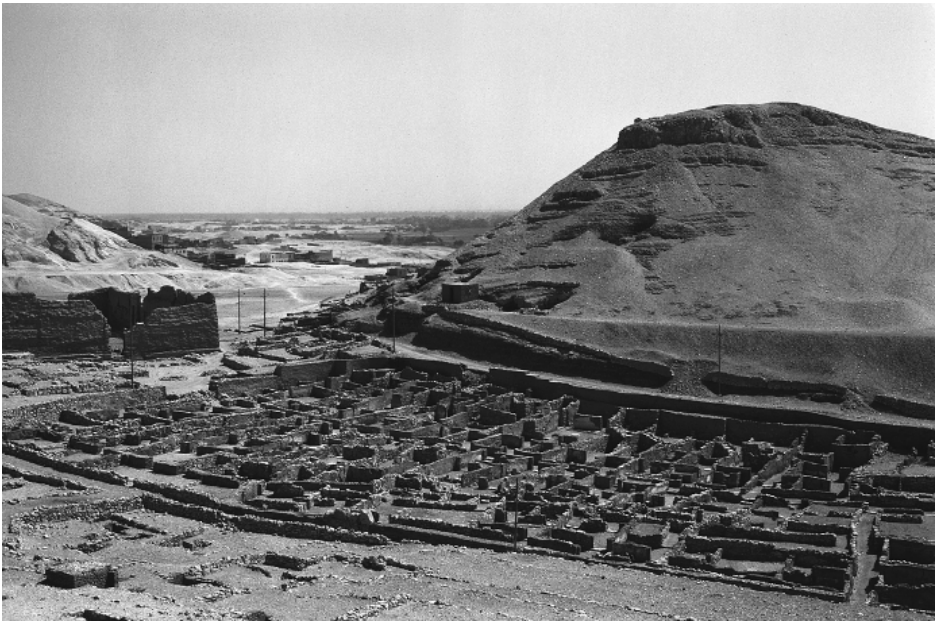


FIGURE 2.7 The village of Deir el Medina, western Thebes, Egypt. Photo credit: Erich Lessing/Art Resource, NY.

The features of these royal tomb plans no doubt reflect Egyptian mapping practices more broadly. The plans seem to be of two types (Rossi 2004, 139–47). In some cases, a plan of the *projected*, but as yet uncut, tomb was prepared, as on the limestone Ostracon Cairo 25184. In others, the plan was the subsequent record of a completed tomb, as in the case of Amennakhte's plan of the tomb of Ramesses IV. In both cases, the plans were carefully divided up into the chambers and passages typical of such tombs, while doorways were indicated in elevation. In the case of the plan of Ramesses IV's tomb (a record rather than a working plan), the king's sarcophagus, set within wooden shrines, was actually depicted in the burial chamber. The mountain in which the tomb lay was also depicted, in elevation. In both the plans just mentioned, linear dimensions were provided, but comparison with the actual royal tombs shows that these are only approximations. Undoubtedly, so far as working plans were concerned, adjustments were made during the progress of the construction, for a variety of reasons (and the projected dimensions may have been only approximate anyway). However, even the plan that records the completed tomb of Ramesses IV does not match up exactly with its actual dimensions. No plan is drawn to scale, although the different components—chambers and passages—are shown in roughly correct comparative proportions.

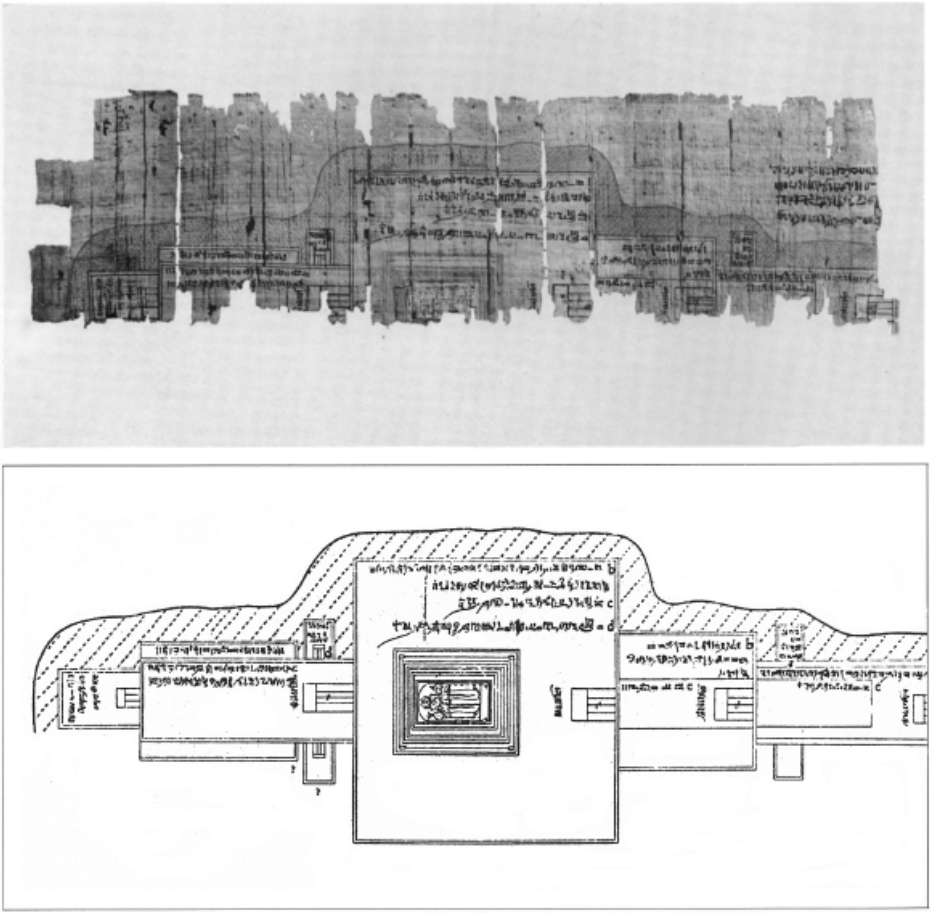


FIGURE 2.8 Detail, papyrus with the plan of the tomb of Ramesses IV, Twentieth Dynasty. Museo Egizio, Turin, Italy. Photo credit: Scala/Art Resource, NY.

All these circumstances suggest that attempts at large-scale mapping (where the problems regarding placement and accurate measurement were much greater) were also likely to be quite schematic, with no exact measurements or any serious attempt at representations to scale. Nevertheless, like the royal tomb plans, such maps could have value for practical purposes, such as planning a journey or an expedition outside Egypt (for trade, mining or quarrying, or military purposes). In addition, maplike records of the Nile Valley in Upper or Lower Egypt, as well as of regions beyond it, may have held some intrinsic interest, and they could certainly be utilized in the representations of foreign regions on temple walls, for example.

FIGURE 2.9 Map of the gold mines: papyrus fragment (A in fig. 2.10 below), Twentieth Dynasty. Museo Egizio, Turin, Italy. Photo credit: Erich Lessing/Art Resource, NY.

We should now turn to "the oldest known geographical map in the world," as James Harrell and Max Brown have described it (1992, 8). This Turin papyrus map (fig. 2.9 and plate 3) has been much discussed since its discovery in the nineteenth century.[13] The treatment here follows the most recent detailed study by Harrell and Brown, although it has been pointed out that their reconstruction of this very fragmentary item—while plausible—cannot be confirmed on available evidence (Janssen 1994, 91). The area depicted is generally recognized to cover part of the Wadi Hammamat, a major geographic feature extending between the Nile Valley and the Red Sea. It served as an important route followed by expeditions going *to* the Red Sea to launch expeditions to Punt and elsewhere, but it was also exploited by the ancient Egyptians for its minerals, especially gold and various types of stone. Harrell and Brown (1992, 100) raise the possibility that the map actually depicts the western (Nile Valley side) mouth of the Wadi Hammamat proper, and like most commentators they believe that it ends in a part of the Wadi today called Bir Umm Fawakhir.[14]

However, these identifications can apply only to the *surviving* parts of the map (Janssen 1994, 91n2). All conclusions or suggestions about what is depicted on the fifteen surviving fragments must be qualified by the possibility that the map may have continued on beyond the surviving left-hand edge; at least it can be ventured that the relevant topography does cease to be depicted near the surviving right-hand edge. In its current state, the surviving portion of the map has been reconstructed as 41 cm high and 2.82 m long (fig. 2.10). However, we might note that another famous papyrus from Deir el Medina, which seems largely (although not fully) complete, measures 25.5 cm high and evidently extended only a little further than its surviving length of 2.59 m.[15] It is

possible, then, that the present dimensions of the map might not be so very much smaller than its original ones.

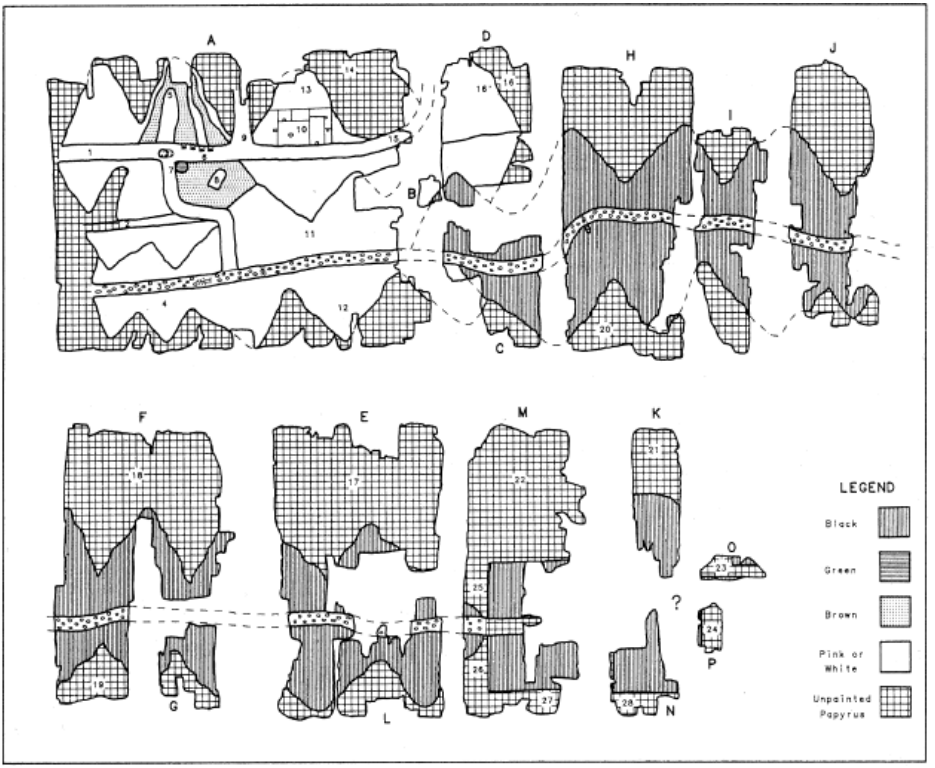



FIGURE 2.10 Reconstruction of the topographical map of Turin. Reproduced from J. A. Harrell and V. M. Brown, "The Oldest Surviving Topographical Map from Ancient Egypt (Turin Papyri 1879, 1899, and 1969)," *Journal of the American Research Center in Egypt* 29 (1962): 84, fig. 3. Reproduced by permission of the American Research Center in Egypt, Inc. (ARCE).

With these reservations in mind, the map can be described as oriented with south at the top, that is, with its left-hand and right-hand surviving edges representing east and west, respectively. Beginning about 54 cm from the surviving right-hand edge, according to the reconstruction of the papyri, the Wadi Hammamat is shown as a single road-like feature or tract, pinkish in color and covered with colored dots to represent a pebbly, desert surface. On either side, high (proportionate to the wadi bed) rugged hills are colored black (brownish to olive) and persist for about 1.62 m. This section of the map is annotated at various points, and the black hills are referred to as the "mountain of bekheny"; bekhen-stone[16] was much desired by the Egyptians and had been quarried in the Wadi Hammamat since early times,[17] as well as specifically during Amennakhte's own day. In fact, the annotations on the map include a reference (at a point about 64.8 cm east of the wadi, "entrance") to the quarrying of bekhen-stone in year 6 of (probably) king Ramesses IV. Further on—about 1.26 m east of the wadi, "entrance"—a note identifies "the place in which they work in the great business of bekhen-stone which was established as a quarry"; nearby, an apparent quarry is actually indicated, immediately next to the wadi floor (Harrell and Brown 1992, 97). The blackish hills characteristic of

this segment of the map correspond to geological reality (fig. 2.11): sedimentary Hammamat siliciclastics here would make the hills appear a "dark brownish-gray from a distance" (Harrell and Brown 1992, 96). On the ground, the black hills depicted on the map would represent about 9.3 km of the winding route of the wadi.

The single line of the wadi floor runs on east of the black hills, to be joined by another wadi floor running south to a third wadi floor running east-west for a distance. These other wadi floors are also depicted as pinkish in tone, but without the "pebbles." High, seemingly rugged hills flank all these wadi floors, including the "main," or pebbled, one; but these hills are consistently depicted as "moderate pink" and correspond on the ground to three different geological deposits which in actuality all appear "pinkish brown" or "pink to pale red" from a distance. Moreover, one hill is shown with radiating brown bands and is specifically identifiable as Fawakhir granite (Harrell and Brown 1992, 95–96). Annotations several times identify the pink hills as "mountains of gold," and they are gold-bearing in reality. In fact, at the foot of the brown-streaked hill four huts are depicted and labeled "the houses of the gold working settlement." To their north is a stela (monument), apparently set up in the open, erected by king Seti I, who is known to have been involved in providing additional water supplies in the eastern desert (Breasted 1906, 81–87); near the stela is a feature labeled "cistern." Immediately west of the settlement, drawn on the face of an adjacent hill, is the schematic plan of a structure called the "shrine of [the god] Amun of the pure mountain," while the hill itself is identified as "where Amun rests."

Finally, to the east, the wadi of the gold workers' settlement and another wadi halfway (on the map) between this wadi and the "main" wadi are both labeled "roads that lead to the sea" (the Red Sea), an important indication that the map is oriented with south at the top. On the ground, the gold workers' settlement has been plausibly identified with Bir Umm Fawakhir,[18] where there are remains of (later) gold workers' huts as well as a Ptolemaic temple to Min that may have replaced the earlier one to Amun. Thus, the pink-hilled segment of the map—occupying a length of about 86.4 cm and overlapping slightly with the area defined by the black hills—would represent about 2.6 km on the ground along the winding route of the actual wadi.

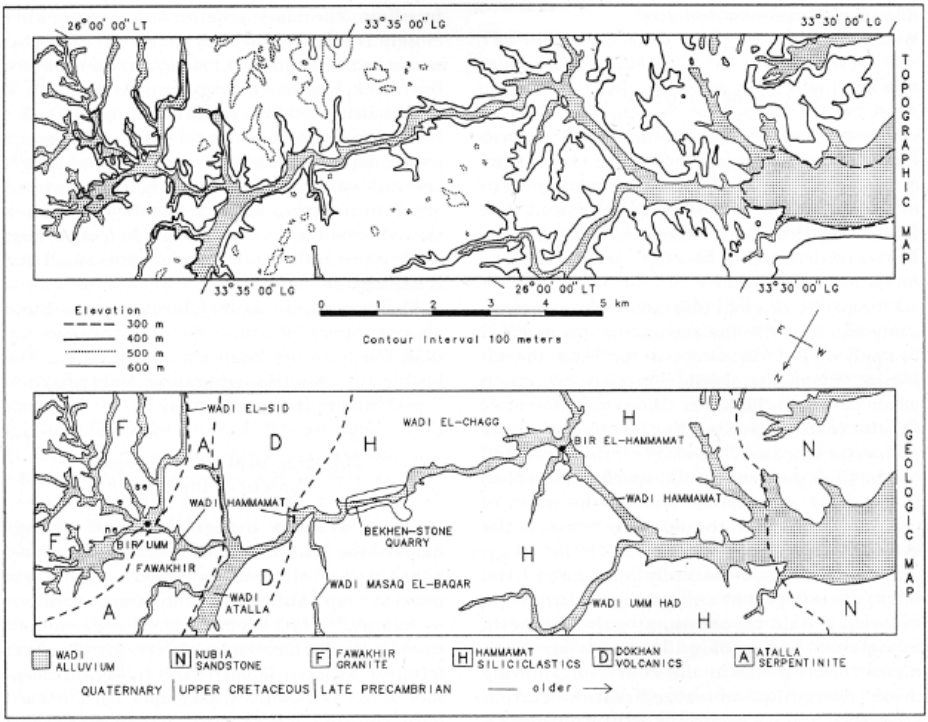



FIGURE 2.11 Topographical and geological maps of the Wadi Hammamat. Reproduced from J. A. Harrell and V. M. Brown, "The Oldest Surviving Topographical Map from Ancient Egypt (Turin Papyri 1879, 1899, and 1969)," *Journal of the American Research Center in Egypt* 29 (1962): 84, fig. 4. Reproduced by permission of the American Research Center in Egypt, Inc. (ARCE).

Altogether, the map is an impressive cartographic record of geological reality. The configurations of the wadis as depicted correlate approximately with the actual disposition of the wadis involved, and the map's close fit with the geological data has been elucidated by Harrell and Brown (1992, 95). Moreover, they even suggest that, by ancient standards, the map is roughly to scale. It is noteworthy that the distance, in linear measurements, "from the gold-working settlement to the mountain of bekheny," is cited, although actual figures are not given (or perhaps have not survived). This inevitably approximate distance recalls the figures (also approximate) occurring on the plans of royal tombs—not precise, but more or less correct and hence still useful. Another fragmentary annotation apparently refers to the time-distance ("one day") between locations; this, too, may have been a datum found on (hypothetical) large-scale maps.[19] Inevitably, the purpose for which the map was created must remain a matter of speculation. Noting that Amennakhte himself may not have visited Wadi Hammamat and that the map is based on information other than his personal observation, Harrell and Brown (1992, 101–4) suggest he may have produced it either as an "aid" for expeditions actually working in Wadi Hammamat, or as a record related to one such expedition or a series of them.[20]

Another feature which does not purport to be cartographic in nature merits attention in this connection. To the right ("west" of the assumed entrance to Wadi Hammamat), near the right-hand surviving edge of the papyrus, there is depicted a series of rectilinear black-colored objects (only partially preserved) which apparently represent individual

pieces of bekhen-stone. They are disproportionately out of scale with the actual map, because the dimensions (breadth and thickness) of surviving pieces average 1.2 m; in other words, each item was substantial but relatively small. It is reasonable to assume that they are the products of a specific quarrying operation, each a neatly dressed block which has not yet been fully worked. One of the blocks (at least three were depicted) evidently had a curving top or edge, as if it was intended for a stela or perhaps a royal sarcophagus or its lid (the actual dimensions of this particular block have not survived). As Harrell and Brown observe (1992, 100), these items may form a kind of instruction or order, identifying the size and depicting the approximate form of several blocks of bekhen-stone which were to be cut from the quarry; alternatively, they may form a record—visual and measured—of the *product* of such quarrying. The distinction is perhaps oversubtle, since the size and purpose of the blocks would have been specified before quarrying began, and they would eventually emerge more or less in accordance with the specifications. In any event, the depiction of these items, together with the fact that the two surviving references to any actual work relate only to the extraction of bekhen-stone, suggests that the map was focused on such operations.

Why, then, the inclusion of the gold-working settlement? Conceivably, the working party—which in the reign of Ramesses IV could range between 408 and 8,362 men!—made use of the settlement and its water supply as a base, because Bir Umm Fawakhir was only about 4 km away from the actual quarry apparently used. Hence, it was helpful (as an aid) or informative (as a record) to include the settlement in the map. Even so, this hypothesis does not explain why so much additional detail was provided, in annotations, about the gold-bearing properties of the relevant hills, or why the identification of routes "to the sea" was given. So while the map may relate to a specific project, it also seems to display a wider, more "academic" interest in the geography and geology of the entire region covered.

Harrell and Brown (1992, 100; cf. 82–83) suggest that the map "may have initially resided in an administrative document pool in Deir el Medina" (along with other "maps"?) and then eventually passed into the assemblage of tombs belonging to Amennakhte's family, tombs representing the actual location where the document was found in the nineteenth century. However, the map might equally have been a personal possession of Amennakhte from the outset, reflecting wide interests and unusual artistic capabilities on both his part and that of his close relatives. He had been a draftsman of Deir el Medina before becoming a scribe. The decorated tomb of his father Ipuy, while often conventional in subject matter, betrays a strong interest in unusual details, such as a depiction of gardeners manipulating shadufs (weighted water buckets) and an unusual and lively rendering of artisans working upon elaborate shrines. One of Amennakhte's sons, Paneferemdjed(i), was a scribe not only of the royal tomb, but also of the "house of life" of some unidentified temple. Such a house of life was the "sacred scriptorium," often attached to a temple and involved in "the composition and preservation of magical incantations (as well as hymns, rituals and even medical potions)" (Ritner 1993, 204–5), but it is possible that aspects of history and geography and the recovery of valuable materials utilized to build and decorate temples were of significance to it as well. In short, Amennakhte belonged to a milieu where there might have been an almost arcane interest in the kinds of data represented by the Turin papyrus map.

It is possible, however, that this map, which follows the conventions of Egyptian art and also depicts partially worked items (the bekhen-stone blocks), was in some measure seen as a basis for another kind of representation—tomb decoration perhaps for an

official who wanted specific commemoration of the associated event as one of his meritorious acts, or even a document desired by the king who initiated the project. Such a document could have been on papyrus,[21] but perhaps something even more ambitious was planned. Occasionally, in royal monumental art, royal statues and obelisks are shown being prepared and installed at the relevant temple, and once even a capstone is shown being dragged to the relevant pyramid site.[22] For the actual recovery of raw materials in exotic places to be depicted is much rarer, but the images from Hatshepsut's temple at Deir el Bahari where incense and ebony are gathered in Punt (noted above) offer an example of such a theme. Was it envisaged that one or all of Ramesses IV's quarrying projects, which were obviously considered of great importance, would be a topic included in the decoration of his vast mortuary temple (perhaps the largest ever attempted) in Western Thebes? If topography were to be included (as in the Kadesh battle scenes of Ramesses II), a map such as Amennakhte's would be an important source of information.

## V. Mythologized Cartography

Another maplike product from ancient Egypt that merits attention is the "Book of the Fayum." Rather than being a unique, self-contained item like the Turin map, this so-called book in fact comprises the remains of several individual papyri, some of which survive only as small fragments (Beinlich 1991; Tait 2003). It combines pictorial and textual material in complex, sophisticated, and technically very accomplished ways. It is a document at first glance religious in nature, with no obvious connection to incipient forms of cartography. Anyone who used it, exposing one conveniently "readable" section after another, would find multiple representations of many deities, almost all with some form of textual labeling attached, unfolding in a seemingly endless sequence before their eyes. The best preserved version (called the "Boulaq/Hood/Amherst" papyrus after the varied collections in which the different pieces resided) is almost 10 m long. Its elaborate iconography and many small-scale texts could never have been taken in at a glance, even if it were on occasion displayed fully extended on the ground or affixed to a wall, both of which are in any case doubtful ideas.[23]

Despite appearances, however, as John Tait explains (2003, 185), "the text as a whole is concerned with places, and is not a catalog of deities. Therefore, in the various horizontal depictions of deities, their names lead directly to their cult places." These depictions include notional geographic or structural features, albeit highly schematized, such as elevated land forms, bodies of water, and buildings dedicated to the cult of a specific god or goddess. In addition, very significantly, careful analysis by several scholars (above all Horst Beinlich) has revealed that both scene and text are organized so as to correspond to and represent, in cartographically correct sequence, the chief geographic features of the Fayum basin, including its once enormous and still extensive lake, as well as many of the towns found in the Fayum at the time when the book was composed. In other words, this document can be described as a mythologized map or, even better, as a maplike representation, in religious mode, of the Fayum as a sacred landscape. Generally speaking, the comparative study of such landscapes—as well as others—in ancient times has become well developed.[24] By contrast, the analysis of ancient Egyptian landscapes from this perspective is only in its initial stages.[25] In this connection, the "Book of the Fayum" is thus an important work, although one

underexploited to date for the wider study of Egyptian sacred landscapes.

The Fayum is a substantial depression not far to the southwest of Cairo, separate from the Nile Valley but connected to it by an arm of the river today called the Bahr Yusuf (fig. 2.12).[26] It fed water into a lake now occupying the northwest sector of the Fayum, but originally possibly "little less than that of the entire Fayum" (Baines and Malek 2000, 18). Today the Fayum lake[27] occupies about 233 sq km; as the lake shrank, the area of available arable land increased and was cultivated, especially from 2000 BCE onward. The lake and its environs were also famous as hunting grounds, and in particular supported enormous numbers of crocodiles (also found in the Nile proper), a factor contributing to the nature of the Fayum's chief deity, Sobek, who manifested himself in the form of a massive crocodile. Sobek, however, was linked to even more august deities, such as Re, the sun god (who was imagined to take on a crocodile form during the night when he swam toward the point at which he would arise the next day), and Osiris, lord of the dead, who embodied the potential for renewed life that Re, by his daily rebirth, actualized. In the "Book of the Fayum" Osiris is mainly regarded as manifested in the fertilizing Nile inundation: this collected in the Fayum lake every year, and its waters were identified with Osiris (Beinlich 1991, 319–24).

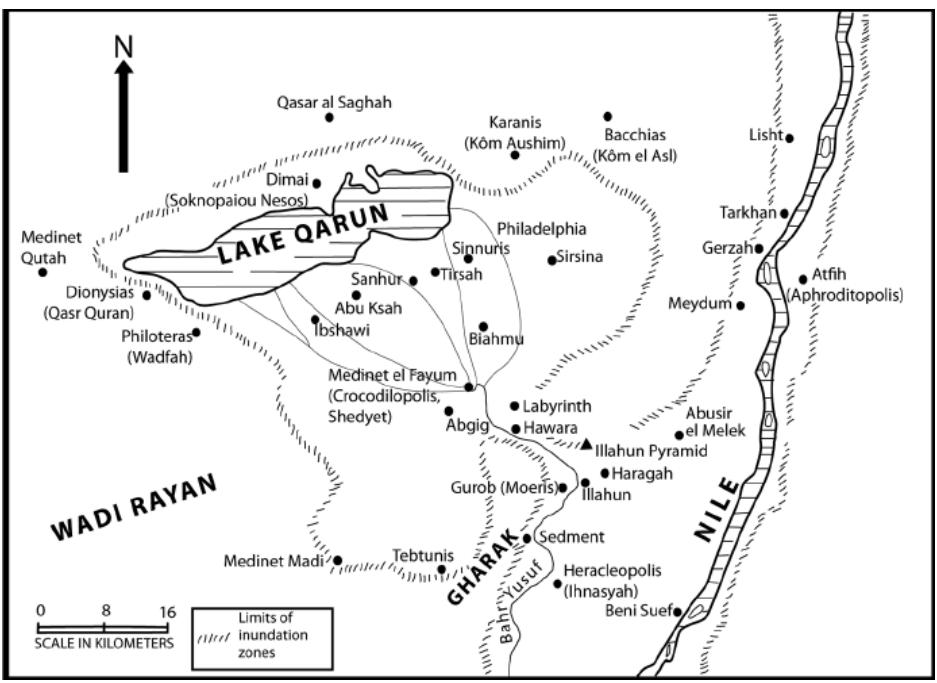



FIGURE 2.12 Map of the Fayum. Redrawn by the Ancient World Mapping Center, University of North Carolina, Chapel Hill, from Hermann Kees, *Ancient Egypt: A Cultural Topography* (Chicago: University of Chicago Press, 1961), 213.

The "Book of the Fayum" is essentially a panegyric dedicated to Sobek, the divine lord of both the lake and region of the Fayum. There were multiple versions of this document on papyrus. In some, the texts are in hieroglyphic and accompanied by illustrations; in others, only the text is found, and then in hieratic, a cursive form of hieroglyphic. In one case, selections from the hieroglyphic text (with no illustrations) were inscribed on the walls of a temple dedicated to Sobek at Kom Ombo in southern Egypt, but all the

papyrus versions are believed to have originated in the Fayum itself.[28] Even though they all date to Egypt's Greco-Roman period (332 BCE–395 CE),[29] their content manifests traditional Egyptian religious ideas and attitudes, with little influence evident from Greek or Roman culture. Notably in this connection, a decorated coffin is known with three vignettes on its inner face similar to ones in the "Book of the Fayum" and may date to Dynasty XXX (380–343), which ended some eleven years before Egypt was conquered by Alexander the Great, marking the start of the Greco-Roman period (Beinlich 1991, 65–66).

## V. 1. THE FAYUM AS A SACRED LANDSCAPE

Turning to the Boulaq/Hood/Amherst version as our primary source for the "Book of the Fayum," Beinlich's analysis (1991, 132–36) has shown that the initial components[30] cover, in mythologized form, the Bahr Yusuf to at least as far as the vicinity of Shedyet (Greek Crocodilopolis), the capital of the Fayum,[31] and the Fayum basin proper, along with its lake (Beinlich's first two sections). The book thereafter becomes more specific, focusing upon particular parts of the Fayum (fig. 2.13). First there comes an elongated section (sec. 3) identified by Beinlich (1991, 308) as the lake itself, along with its banks.[32] Beinlich's section 4 focuses on Shedyet, the capital of Fayum and the location for the chief temple of Sobek in the region. It lies in the southeast quadrant of the depression and was once perhaps much closer to the lake (in, say, about 2000 BCE). Section 5 moves on to Ro-sehwy, an Egyptian place-name plausibly identified as near to (or identical with) the Greek-named Bacchias in the northeast corner of the Fayum. Section 6 is concerned with "the Acacia of the goddess Neith," a cult center and presumably town which Beinlich suggests lay between Karanis/Kom Aushim and Sanhur, in the northeast quadrant of the Fayum. The importance of Shedyet in a Fayum-based document exalting Sobek seems self-evident, but it is less clear why these other two centers are singled out. However, Ro-sehwy had Sobek as its principal deity, while in the Fayum Neith, primarily the goddess of Sais in the delta, played in mythological terms—like some other goddesses—the role of Sobek's divine mother (Beinlich 1991, 308, 325–26).

Finally, after a depiction (sec. 7) of the primeval gods and Nun, the book concludes with section 8. This includes a representation which some scholars interpret as including a (schematic) depiction of the actual temple of Sobek in Shedyet. However, Beinlich argues instead that the focus is actually on the Fayum lake: it is represented by a rectilinear body of water, above which is set an image hieroglyphic in character and signifying that the lake itself is to be seen as embodying the temple of Sobek at Shedyet.[33] Next to it, a "name ring" refers to an aspect of the lake too, by recording the names of the more important deities to which the lake was believed to give birth.

At first glance, the "Book of the Fayum" creates the impression of a logical sequence in geographic terms—beginning with the Bahr Yusuf and next proceeding to the entire Fayum. But thereafter it seems to move more erratically—to the Fayum lake, then southeast to Shedyet, then directly north to Bacchias, and then off roughly to the southwest, the supposed (and very approximate) location of the Acacia House of Neith. Perhaps, having first defined the overall region of the Fayum and its lake (an area definitely envisaged as extending to Shedyet at least), the designer of the book then wanted to focus down on particular entities *within* the region, much as we today might add specific places after having outlined a general regional map. As to the seemingly

zigzag sequence that the designer comes to adopt, it may reflect a hierarchy of importance, dictating that the specific places be referred to along a scale of decreasing significance: the lake, Shedyet, Ro-Sehwy/Bacchias, and the Acacia House of Neith. Equally, however, within the particular sequencing imposed upon the composition by the format of an elongated, narrow papyrus roll, we may be seeing an expression in an Egyptian context of a phenomenon observed in some "sacred" and other conceptualized landscapes elsewhere. This involves the concept of what have been termed "nested landscapes," "where family, kin, community, gender and age/experience would have linked land, dwellings and ceremonial spaces."[34] At least insofar as public and mythical landscapes are concerned, the "Book of the Fayum" could be seen in these terms, especially since for the Egyptians the cosmos was mimicked or miniaturized at many different levels, including perhaps house and palace, certainly temples, provinces, regions, Egypt itself, and the world at large.

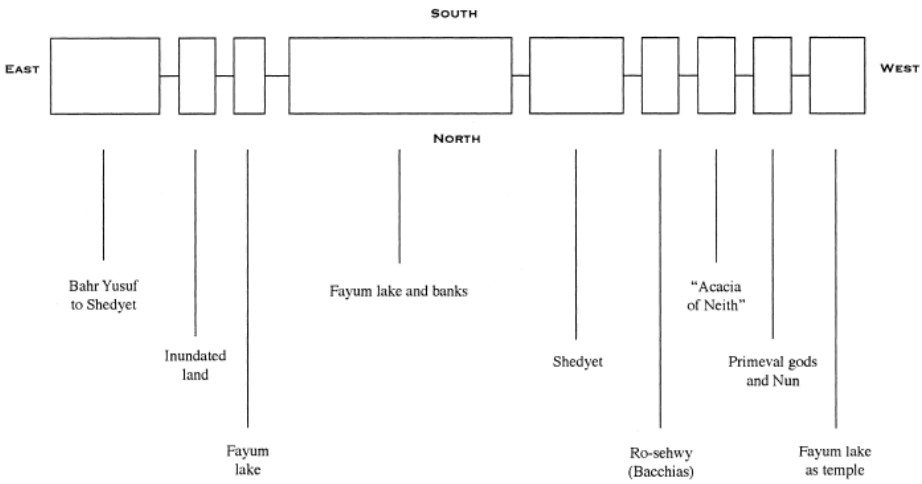



FIGURE 2.13 Schematic diagram: the sections of the "Book of the Fayum" correlated with Fayum topography. Drawing by David O'Connor and Laurel Bestock.

## V.2. THE COSMOGRAPHY OF THE "BOOK OF THE FAYUM"

Within the set of vignettes and texts making up each of its sections, the "Book of the Fayum" interweaves complex references to notional features defining or comprising the Fayum, its religious centers (implicitly with surrounding towns expressive of social and political systems), and the mythological beings and events crucial to the functioning of the cosmos from the perspective of the Fayum and its primary deity, Sobek.

Section 1 is structured around a single long waterway rendered, as are all the other sections, with south at the top (like the Turin papyrus map). The north-south division, referred to explicitly several times in the book, is based on a notional east-west axis (in actuality, southeast to northwest) corresponding to the geographic structure of the Fayum itself, particularly the positioning of the Bahr Yusuf, its dispersal channels, and the lake (Beinlich 1991, 302–6). The waterway is named as such, along with its mythological associations—it nourishes the body of Sobek; Re, the sun god, is within it, and Osiris relates to it, as does Horus. In the subsequent vignettes it is the goddess Mehetweret who will be shown giving birth to Re, as he literally emerges from the lake filled by the waters that she embodies here. The Bahr Yusuf is depicted as a single channel, filled with water (though the requisite conventional marking for it is absent on

the Boulaq/Hood/Amherst version) as well as flanked on either side by its denizens (fish below, waterbirds above) and then the vegetation growing along its banks. At top and bottom are depictions of individual deities, each linked to a specific town or place along (in the map) the south and north sides of the Bahr Yusuf to somewhat farther west than Hawara. Thus, the representation is in effect a schematic map, corresponding in form and sequence to reality but articulating the divinity which finds expression through the natural and built forms involved. At the far left, two representations of "sand slopes" perhaps signify the actual entry place of the Bahr Yusuf into the long narrow depression leading into the Fayum. Moreover, at the cosmological level, the two sand slopes protect the Fayum and its sacred beings from the aggressive god Seth, who was regarded in negative terms by the Greco-Roman period.

There follows in Beinlich's section 2 a splendidly drawn vignette of the goddess Mehetweret (fig. 2.14). Here she is shown in human form, although she is the primeval cow goddess who gave birth to the sun god; she is also associated both with the celestial waters traversed by the sun god as his solar cycle daily unfolds around the cosmos, and probably with the Milky Way straddling the nocturnal sky. Beinlich persuasively argues that Mehetweret is identified with the arable and marshy lands of the Fayum that are irrigated by the multiple streams radiating out from the Bahr Yusuf and signified by the two waterways literally curving out of her elbows. This terrestrial expanse terminated at the great lake itself, which is represented in the next vignette of section 2.

Here the lake is seen as the place of solar rebirth, with Re literally half-emergent from its waters (fig. 2.15), as if the lake represents the amniotic sac and birth canal of Mehetweret, who is shown in the appropriate position to give birth to Re. However, the lake also embodies the interface between external chaos and the orderly interior world which constitutes the cosmos; the Fayum's god, in the form of Sobek-Re, traverses the northern and southern parts of the lake in a celestial boat. Thus the endlessly repeated cultic regeneration of Sobek is equated with the endless rebirths of the sun, and Sobek's eternal existence with the repeated experience of the solar cycle.

Section 3 shows the lake as an immensely elongated oval, in which are depicted deities who dwell in its mysterious depths, and then (in some versions of the book) the fish which dwell in its upper waters. At top and bottom are various cultic centers running along the banks of the lake, manifested by the relevant deity and representing actual places, not all of them necessarily towns or settlements.

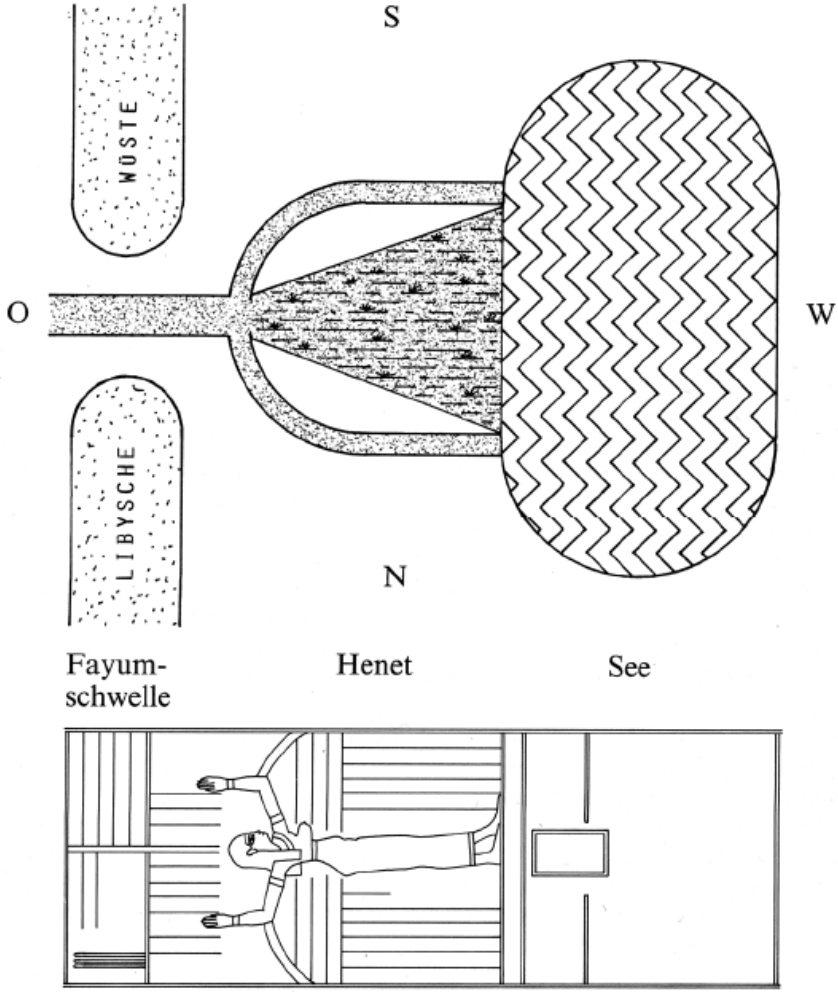



FIGURE 2.14 The "Book of the Fayum," second section, correlated with the topography of the Fayum. Reproduced from H. Beinlich, *Das Buch von Fayum*, Textband (Wiesbaden: Otto Harrassowitz, 1991), 85, abb. 25, with permission of the publisher.

Beyond, in section 4, the next vignette focuses on Shedyet and is not very well preserved. Its most conspicuous surviving feature is a dense cluster of compartments in which the primeval deities are organized according to the province or region to which each was central; each deity has taken on the crocodile form of Sobek, as if he can manifest himself as any of these powerful beings or even all of them, and in fact assume the role of the creator god. In reality, chapels representative of these deities would have clustered together within the actual temple of Sobek in Shedyet or around it, thus assigning to the Fayum, in Beinlich's view, "the central position . . . within the cosmos," with the Fayum as "the egg, as the seed . . . the place of origin for the generation of Upper and Lower Egypt" (1991, 121; author's translation). From section 4, as we have seen above, representations and text move on to two further cult centers (secs. 5–7) of significance to Sobek's cult and mythology, and then to the concluding vignette (in sec. 8).

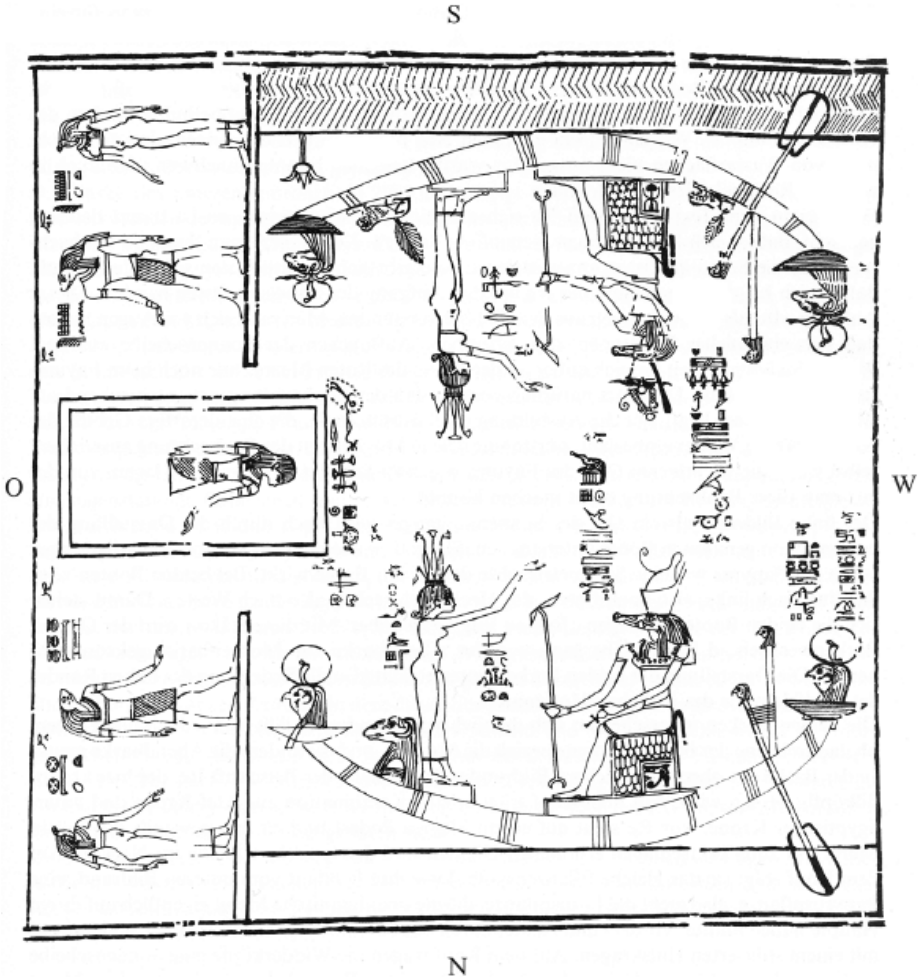



FIGURE 2.15 In the "Book of the Fayum," second section (fig. 2.14, bottom right), Re emerges from the Fayum lake (*center left*) while Sobek-Re sails over the lake and mimics the solar cycle. Reproduced from H. Beinlich, *Das Buch von Fayum*, Textband (Wiesbaden: Otto Harrassowitz, 1991), 85, abb. 26, with permission of the publisher.

## V.3. FUNCTION AND READERS

The function of this extraordinary book, which has few if any close parallels in Egypt, has been much discussed. One point seems certain: given the book's content, and the sophistication displayed in both text and image, its various examples are products of "houses of life" (mentioned above) that were attached to temples and no doubt encompassed a surprisingly wide range of information in their records. After all, the breadth of interests typically assigned to Egyptian deities was expansive: they focus simultaneously on cosmic issues, national concerns, and local or regional needs. All these houses of life were probably located in the Fayum itself, although other centers of Sobek's cult surely utilized the ideas and matter represented, as evidenced by the wall inscriptions at the temple of Kom Ombo.

What use might have been made of the multiple versions of the "Book of the Fayum," which was a "fixed and well known text" (Tait 2003, 201)? Its primary users and "readers" were presumably priests during the Greco-Roman period, within a milieu

where temples and their houses of life had become the primary custodians of traditional Egyptian concepts and data, and elaborated upon them further. Tait (2003, 202) seems to regard examples of the "Book of the Fayum" as utilitarian in function (in an exalted sense): "Its mix of scribal and artistic dexterity and the eloquence of its longer textual passages were seen as essential in priestly training." However, it remains conceivable that the book was sometimes a source of inspiration to fully professional priests interested in its matter for its own sake. Moreover, some or all of its verbal content might have been employed in temple liturgies; this can be imagined especially of papyrus rolls bearing only the text of the book, written in a hieratic script which educated priests would have found relatively easy to read, and lacking illustrations.

Even so, the most elaborate versions of the book do not readily fit any of the possible functional categories just mentioned. These versions—the lavishly and skillfully illustrated Boulaq/Hood/Amherst example among them—always have their texts in the hieroglyphic script, the one most esteemed and normally chosen to accompany images on temple walls. As both Beinlich and Tait observe, the "reader" of such a version of the book faces awkward issues—when, for example, some of the texts actually present themselves upside down due to the compositional requirements of the images to which they relate. Moreover, while some informative images—such as the vignette depicting the Fayum lake with Sobek-Re twice sailing upon it, or the concluding vignette—could be displayed in their entirety in the normal practice of reading a papyrus roll, others, such as the enormously elongated version of the lake, could not. In addition, the full richness of the illustrations, and in particular their carefully structured layout overall, are aspects of the book that could not be easily absorbed by means of normal reading practice. On the other hand, as noted above, the idea that the entire unrolled papyrus was displayed all at the same time poses problems of its own.

Altogether, these issues and the nature of such examples of the book—combining hieroglyphic text and image in a mode that recalls temple decoration without being by any means identical to it—seem to envisage a reader who would be unimpeded by any of the problems discussed, namely, the god Sobek-Re himself, an omniscient being free from such physical difficulties (fig. 2.16). Deities were provided with a multiplicity of votive objects intended to honor, attract, and placate them, above all richly inscribed and illustrated temples of their own. It is possible that the most elaborate versions of the "Book of the Fayum," produced in the house of life, were then ceremonially deposited in the vicinity of the shrine of Sobek for his support and delectation. There each would stay indefinitely, rolled up and secure, until it was either ceremonially removed and disposed of (at intervals old votive items had to make space for new ones), or by accident it ended up in the rubbish heaps where such items were sometimes found.

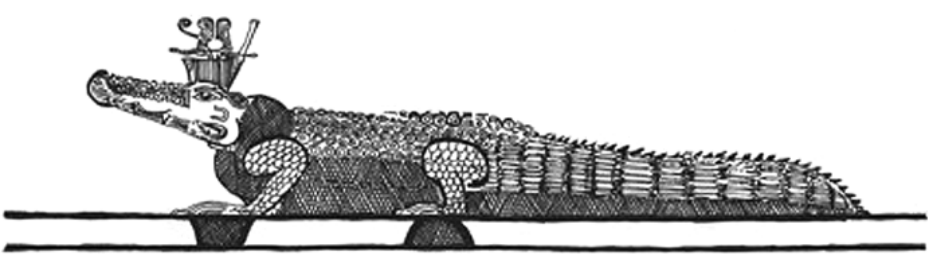


FIGURE 2.16 The god Sobek from the "Book of the Fayum." Reproduced from H. Beinlich, *Das Buch von Fayum*, Textband (Wiesbaden: Otto Harrassowitz, 1991), 85, abb.

43, with permission of the publisher.

## VI. Final Observations

The "maps" discussed above—the Turin papyrus and the "Book of the Fayum"—are the two produced by the ancient Egyptians that come closest to our modern concept of a map. Seemingly unique in each case, these "quasi maps" from Deir el Medina and the Fayum respectively are likely to have counterparts not yet discovered. More generally, they represent a strong sense of place as an orderly and recordable phenomenon that is reflected in a wide variety of the products of ancient Egyptian civilization. Some of these there has not been the space to include in the present discussion, although they should be noted—in particular, maps of the sky (based on direct observation)[35] and depictions of the geography of the underworld, the world of Osiris and the dead. The latter maps, found first on elite coffins and later (during the New Kingdom) on the walls of royal tombs, are purely imaginary. Nonetheless, such maps of the underworld evidently had great meaning to the Egyptians, not to mention a specificity that even involved the inclusion of dimensions, albeit on a fantastically large scale, appropriate to this mysterious realm.[36]

For Egyptians to make maps in forms closer to modern concepts was to some degree impossible, because technical difficulties prevented accurate surveying of topography or of large-scale, built environments such as cities. Nevertheless, despite these limitations, Egyptian achievements in cartography are impressive and exciting, the more so when maps such as the Turin papyrus map and the "Book of the Fayum" are likely to constitute only the merest random samples of cartographic initiative. Particularly important is the evidence for an interest in landscape and topography in their own right, as much as in data needing to be recorded for purely utilitarian purposes. The detail of the Turin papyrus map indicates such a concern for landscape, while the "Book of the Fayum" renders topography with relative accuracy, at the same time as suffusing it with mythological significance. The better examples of Egyptian sky maps just mentioned are also noted for their accuracy as well as for the subtlety with which the temporal progressions of celestial phenomena are conveyed; by the same token, the transformation of celestial data into vividly rendered landscapes of the netherworld attests to extraordinary imagination.

Unquestionably, Egyptian maps and architectural renderings provided guidelines rather than the precise, fully detailed information found in their modern counterparts. Even so, Egyptians leave no doubt of their ability to perform, as it were, cartographically. Maps provided approximate itineraries for their expeditions abroad; they could be consulted in conjunction with the accumulated experience of Egyptian expedition leaders and their staffs, and with the use of local guides, such as the Puntites who accompanied the expedition dispatched by Hatshepsut during its remarkably deep penetration of northeast Africa. In the Nile Valley, Egyptians were capable of laying out complete towns, covering hundreds of hectares and involving a high degree of rectilinear planning; "master plans" must have preceded such initiatives, yet in all likelihood these were relatively approximate in nature. Actual construction was carried out under the supervision of master builders, who filled in the details with reference to their practically acquired skill and expertise.[37]

In short, the Egyptian sense of structured space, whether naturally formed or involving built components, found a variety of expressions: maps and diagrams on the

one hand, and the actual application of the knowledge they provided on the other. There is engagement here with all the major spheres of Egyptian life—political, economic, and religious. The interface between the two processes produced tantalizing masterpieces, of which further examples—no doubt with many problems of presentation—may well be discovered in the future.

# THREE

## Mapping the World: Greek Initiatives from Homer to Eratosthenes

**Georgia L. Irby**

### Introduction

In 423 BCE, when the comedy *The Clouds* was first produced at Athens, the two most powerful Greek city-states and bitter rivals, Athens and Sparta, had been at war for several years (fig. 3.1). Much of the literature of that period reflects the social and political anxieties felt by all Athenian citizens in wartime. In this connection, the author of the *Clouds*, Aristophanes, ingeniously employs a map as a focal point of the geography of contemporary politics. In the comedy, Strepsiades, an everyman Athenian farmer, argues with his son Pheidippides over his profligate lifestyle of horseracing and gambling but fails to talk his son into enrolling in college. In fear for his own economic security, Strepsiades decides to attend college himself in order to learn the art of persuasion: he aims to talk himself out of his debts. As he awaits his meeting with the principal, a comically exaggerated Socrates, he tours the grounds of the school, the *Phrontisterion*, asking his student guide about various astronomical and geographic instruments there. When prompted, the student explains geometry as the science of measuring land and, by way of explanation, points out a map of the Greek world on display. Strepsiades asks to be shown Athens and his neighborhood within it, and the student obliges. However, when Strepsiades asks the student to show him where his friend Cicynna might be, the exasperated student dismisses the question, and instead draws attention to Euboea, a "long island lying off the coast." Strepsiades then asks where Sparta is. The student obligingly points it out, indicating its spatial relationship to Athens. Strepsiades's reaction, in alarm at the proximity of the enemy state, is a vehement demand that the student move Sparta further away (*Clouds* 200–18).

This charmingly naive scene reveals something about Greek maps and Greek attitudes toward them. Large-scale maps were known in Athens from the fifth century onward, and they were symbolically powerful. Both practical and artistic, they were displayed in private and public places. For example, in his will,[1] Theophrastus (d. 287/6), who had studied in Athens under Plato and Aristotle, requested that a world map painted on wooden panels be displayed at the Lyceum, where he himself had taught. This Athenian institution, founded by Aristotle, was a semipublic place for exchanging knowledge. Likewise, in the *Argonautica*, an epic tale of the sea journey of Jason and the quest for the Golden Fleece, the third-century poet Apollonius of Rhodes refers to maps on display on pillars at the court of Medea's father, King Aeëtes, "on which are all the roads and paths of the sea and land flowing all around" (4.279–81). Founders of colonies drew maps to demarcate the allotment of lands and resources to the community, gods, and settlers. On a wider scale, Greek writers compiled lengthy geographic descriptions of the Mediterranean world. Among the most important of them is Strabo (ca. 30 BCE–24 CE), who was born in the Black Sea region, worked in Rome, and traveled widely. In his *Geography* of the Mediterranean world, comprising seventeen books, he describes a

celestial globe which showed the celestial sphere marked with the major zones of latitudes and the ecliptic (the sun's apparent orbit around the earth: 1.1.21).

FIGURE 3.1 Greece, the Aegean Sea, and western Asia Minor. Reproduced with permission of the Ancient World Mapping Center, University of North Carolina, Chapel Hill.

Greek maps undoubtedly reflected the prejudices and philosophies of those who made them. Geometric aesthetics and philosophical beliefs dictated the shape of the entire world (cylindrical or spherical) and of the inhabited portion of it (the *oikoumene*). At its center might be placed the mapmaker's own city-state (*polis*), or some site of particular cultural importance. In all likelihood the *Phrontisterion* map, to be used by students in Athens, would have shown either Athens itself at its center, or Delphi, a "central" religious site where worshippers sought advice on many issues including colonization, or Delos, the small Aegean island chosen as the meeting place for the fifth-century league that Athens provocatively transformed into an empire.

Greek maps stemmed from abstract philosophical theories, and the geographic texts which explained them treated not only topography and relative distances, but also cosmogony and humanity's place in the universe. Cartographers and geographers were guided by various precepts drawn from the Greek sense of aesthetics, superiority, and vanity. Greeks were aware of climatological differences and consequently developed a theory of geographic determinism: climate—a combination of latitude, longitude, and weather—shapes character.[2] For the Greek historian Herodotus (fl. ca. 445–420), this is a connective theme: Egypt's unique climate results in peculiar topography and customs (2.35); Greece is the best land because of its moderate and temperate climate (3.106); by

contrast, a climate where the living is too easy produces soft men (9.122). The unnamed author of the Hippocratic treatise *Airs, Waters, Places* (fl. ca. 430–400) explains (12, 14) how climate accounts for character: Asia is mild and fertile, being close to the east, but its people are indolent and submissive; the northern Scythians are chilled, watery, and almost barren, like their wintry land; variable climate accompanies variable terrain and produces peoples of more changeable character and livelier and freer minds. Strabo (6.4.1) famously attributes the rise of Rome to Italy's temperate, yet varied, climate.

Pictorial maps may have accompanied geographic treatises. Anaximander of Miletus (fl. ca. 600–545) is said to have drawn the first Greek geographic map, and he may have written a book entitled *Circuit of the Earth*. Hecataeus, also from Miletus (fl. ca. 520–490) and author of the first systematic textual description of the world in Greek, may have included a map with his book. In producing physical maps, Greeks used the essential scientific tools of mathematics and astronomy, but they also relied upon a variety of written and oral sources, including what they learned from mariners. Cartographic data are integral to Greek expeditionary treatises[3] and histories, as well as to those guidebooks which list and describe places in the order encountered while traveling along a road (*periegesis*, "trip around the world") or coast (*periplous*, "a sailing around"). Cartographic advances were made especially during times of intense colonization and interstate trade (700–500, when the Greeks extensively colonized the Mediterranean) and of foreign warfare (500–480 and 340–323, against the Persians). The practical knowledge gained from military expeditions encouraged Greek cartographic initiatives. Although the actual maps rarely survive[4]—and maps were almost never included in manuscripts—some maplike descriptions do: the information was considered useful, worth copying, and often entertaining. Early Greek maps, like those made by Babylonians and Egyptians discussed in this volume, could range in scope from city plans or mine tunnels[5] to geographic regions or the entire inhabited world.

## Challenges to the Study of Greek Cartography

We cannot know how many Greek maps were produced, or what exactly their content and purpose may have been. The different materials on which they were presented have rarely survived. Papyrus and vellum are perishable; bronze and other metals were frequently melted down; stonework and mosaics were stolen, defaced, or buried. Our reconstructions must therefore depend upon later descriptions by authors sometimes removed from the original artifacts by centuries: Strabo, for example, lived three centuries after Eratosthenes (fl. ca. 276–194), whose work he described. Texts preserve merely a selection of descriptions of the original maps, and their authors often interpret as much as they describe. They employ similes and evoke familiar geometric shapes and objects from daily life: Sicily is triangular, Attica crescent shaped; the Peloponnese resembles the leaf of a plane tree, Italy an oak leaf.[6] Further, how accurately writers quote their sources we cannot say. Geographic reconstructions are by their very nature interpretative and speculative. Because the textual descriptions reflect the knowledge and theoretical initiatives of the culture which created them, our understanding of this material and our resulting images are reliant upon an adequate grasp of it. As with translating literary texts, there is ample room here for misrepresentation, factual distortion, and philosophical misinterpretation of geographic texts. Moreover, geographic data are easily garbled in copying. Maps too large to be incorporated into papyrus rolls

and vellum codices were liable to be separated from their manuscripts and then further damaged or lost. Although maps were useful, artistic, and of immense symbolic and practical value, they may also have suffered from intellectual prejudices against material artifacts, which some considered to be secondhand imitations of life appealing to humanity's less rational nature.[7]

Issues of scale and perspective further obstruct us. Greek mapmakers were prone to exaggerate the size and importance of their own surroundings; for more remote regions, the scale grew smaller and the details fewer. Strabo even claims that the need to know about distant places is minimal: "For purposes of government there would be no advantage in knowing such countries and their inhabitants, particularly if the people live in islands which are such that they can neither injure nor benefit us in any way because of their isolation" (2.5.8). Moreover, there was no absolute Greek unit of length for measuring distance. To be sure, one *stadion* was reckoned as 600 Greek feet, but a standard "foot" was lacking: at Olympia one *stadion* was 192.8 m, the length of the stadium there, while the Athenian *stadion* measured 185 m, and the Egyptian only 157.5 m. In addition, before the time of Alexander the Great (356–323) there were no coordinated efforts to map the Mediterranean world.

Greeks realized that maps and geographic knowledge have political value. Alexander engaged "bematists," men whose sole job was to measure distances between places.[8] Strabo (1.1.16) asserts that maps are useful to governors, who can better manage affairs if they know the size of a country, the lay of the land, the peculiarities of sky and soil, and the local peoples and their customs. In his view, maps also benefit hunters for understanding the character and extent of a terrain, and commanders for pitching camp, setting ambushes, and marching in unfamiliar territory. Even so, Greek interest in mapmaking and in describing the topography and the location of settlements predates the first formal illustrative maps. Indeed, such interest goes all the way back to Homer, whom Strabo (1.1.11) called the "father of geography."

## Homer

Attributed to Homer and committed to writing in the mid-eighth century are the earliest extant Greek literary works, the *Iliad* and *Odyssey*. They recount episodes from the Trojan War, and both reflect a strong geographic curiosity and awareness. Homer was clearly engaged by the nature of the world, its origins, its shape, and the relationships between places. In his lengthy catalog of Greek ships (*Iliad* 2.494–759), he lists 29 contingents, 44 Greek leaders, and 175 towns and locales by name.[9] The catalog incorporates topographical details for many places: Aulis and Pytho are rocky; Eteonos has many hilly valleys; Asine lies down a deep gulf. Of particular importance is proximity to the sea: Chalcis and Antron are by the shore; Cerinthos is a seaborne island; the landlocked Arcadians, to whom "the work of the sea was nothing," had to borrow ships from King Agamemnon. Certain places are characterized by weather: Euboea, whose "wind was fury"; "wintry" Dodona. Human and political data are likewise noted. Thus, places are distinguished by landmarks: strong-founded citadels at Medeon, lower Thebes, and Mycenae; Tiryns of the huge walls. Populations, too, are tallied: Crete is said to have one hundred cities. Several sites are characterized by economic strength: Arne and Histiaia of the great vineyards; silver-shining Lycastos and Cameiros; Iton, mother of sheepflocks. Some peoples' physical characteristics and fighting skills are noted: the Abantes (of Euboea) "their hair grown long at the back," who are "furious spearmen"; the Arcadians

fight at close quarters. Herodotus, Strabo and other geographic writers would later incorporate similar information into their own geographic accounts.

In Homer's catalog, details regarding the spatial relationships between places are limited, restricted usually to neighboring bodies of water: Lilaia, for example, is beside the wellspring of the river Cephisus; Doulichion and Echinai are across the water from Elis (far across, according to modern maps); Pherai is beside Lake Boebeis. Sites are grouped in rough geographic succession, spiraling clockwise from Greece north of the Corinthian isthmus, to the Peloponnese, the western islands and western Greece, southeastern islands, and finally northern Greece. Exceptionally, the southeastern islands (Crete and its environs) are inserted between the western islands and northern Greece. The catalog omits altogether many Aegean islands and *poleis* of Asia Minor which were of considerable historical importance.

Within each region, Homer proceeds only roughly in a circumnavigational fashion, ordering place-names according to the demands of his poetic rhythm rather than the practical considerations of a journey. The *poleis* of Euboea, for example, are listed as follows: Chalcis, Eretria, Histiaia, Cerinthus, Carystus, Styra. In reality these are all coastal communities located as follows from north to south: Histiaia (north shore), Cerinthus (east), Chalcis, Eretria, Styra (all west), Carystus (south). Although Homer's catalog is the earliest Greek map-type description, an actual map cannot be drawn from it.

Opinion is divided over the catalog's origin, purpose, and geographic veracity. Some scholars consider it a much later insertion into the *Iliad*, because the contingents listed as important (such as the Boeotians, listed first) turn out to play no significant role in the action of the epic; in addition, places not founded until the eighth century (four centuries after the Trojan War) are included, as well as sites of no Bronze Age importance, Athens among them. It may be true, as many argue (Dickie 1995, 29–30), that Homer's attempt to re-create the Mycenaean past was largely imaginative and self-conscious. Others conclude that the catalog preserves an accurate record of expeditionary forces, modified appropriately for inclusion in an account of an episode late in the Trojan War (Willcock 1976, 23). Certainly it is likely that the catalog reflects Homer's contemporary geography projected onto an imagined landscape of the Bronze Age Mediterranean.

The *Odyssey*, with its tale of a Greek hero's homeward sea journey from Troy featuring geographically relevant details, reads in part much like a technical sailing log, a *periplous*. Homer paints vivid topographies of Sicily, of the wind god Aeolus's island, of Circe's island, Aeaea, and, fancifully, of the Underworld. It is no surprise that a poetic account of a sea journey would also furnish rich maritime data, including harbors and anchorages in Aeaea ("fit for ships"), Sicily ("where the harbor is easy, with no need for a hawser or anchor stones"), and northern Europe (the harbor of the Laestrygones is "glorious") (Hexter 1993, 139).

Moreover, Odysseus, like any sailor, was deeply concerned with the winds, and he knew them well. His diligent observations suggest growing efforts to map them, a critical step to nautical cartography. By the winds (named for the direction from which they blow), one can occasionally trace Odysseus's path: a west wind carried his ship from Aeolus's island to Ithaca; southerly and easterly winds prevented him from leaving Thrinacia, the island of the sun god (well to the east, where the sun rises; he needed to travel west or north). After he left Ogygia, Calypso's island, the west wind ceased to blow, and a south wind blew him back past Scylla and Charybdis, driving him ultimately

toward Scherie, the land of the Phaeacians.

In the *Odyssey*, as in the *Iliad*, explicit directional and spatial details are few. The suggestion that Ethiopia is a divided territory—some Ethiopians dwell in the east, some by the setting sun (*Odyssey* 1.22–24)—is unusual, as is the clarity of Circe's directions to the Underworld: "Let the blast of the north wind carry you. But when you have crossed with your ship the stream of Ocean, you will find there a thickly wooded shore, and the groves of Persephone, and tall black poplars growing, and fruit-perishing willows, then beach your ship on the shore of deep-eddying Ocean."[10] Circe's directions and her landmarks are vivid. The Underworld is a difficult destination only for its remoteness, and a map is hardly necessary. Furthermore, Homer's description of the journey suggests something about the accepted view of the shape of the earth. He writes that at its limit "lie the community and city of the Cimmerian people, hidden in fog and cloud, nor does Helios, the radiant sun, ever break through the dark, to illuminate them with his shining, neither when he climbs up into the starry heaven, nor when he wheels to return again from heaven to earth, but always a glum night is spread over wretched mortals" (*Odyssey* 11.13–19). This description implies a flat worldview and a sun whose path across the sky does not change regardless of the season.[11]

According to Strabo (1.2.7), the third-century scholar Eratosthenes (see further below) rejected all attempts to map the sites to which Odysseus ventured in Homer's epic. Yet scholars contemporary with Eratosthenes proposed likely equivalents for several of the places featured there. The truth is, however, that these cannot be identified conclusively, and modern scholars continue to dispute the geographic integrity of Odysseus's journey. Certainly, Homer's descriptions of Ithaca and surrounding islands are not corroborated by geographic facts, and his references to Egypt, Cyprus, and Phoenicia suggest the political geography of the eighth century, not of the Bronze Age Trojan War era.

It is unlikely that Homer used maps or knew of them.[12] The opulent artwork on Achilles's shield (*Iliad* 18.483–607), however, strongly suggests an early attempt at mapmaking. Hephaestus, the Greek god of the forge, created a great shield with five layers of metallic laminate and a triple-layered metallic rim. The shield's face was decorated with a gold plate in the center, two plates of tin, and two of bronze. One of the bronze plates engraved onto the shield showed the earth in its relationship to celestial bodies: "[Hephaestus] made the earth upon it, and the sky, and the sea's water, and the tireless sun, and the moon waxing into her fullness, and on it all the constellations that festoon the heavens, the Pleiades and the Hyades and the strength of Orion and the Bear, whom men give also the name of the Wagon, who turns about in a fixed place and looks at Orion and she alone is never plunged in the wash of the Ocean." Hephaestus then depicted two cities, one of peace, another of war, and around the "uttermost rim" he engraved Ocean, which was thought to circle the earth. In short, the shield is a synthesized microcosm of Homer's world, both terrestrial and celestial. It was not intended to communicate a physical geography, but it rather served as a generalized and metaphorical depiction of human activity and the interdependence of humanity with surrounding environs, a powerful image of the cosmos (Hardie 1985, 11).

Despite Homer's geographic curiosity and awareness, only the vaguest of maps could be generated from his data, comprising little more than a set of cardinal points. His geography lacks a frame within which to delimit boundaries. Nonetheless, early Greek sailors knew the nautical and geographic markers scattered along well-established shipping lanes. "By connecting these dots, as it were, an outline of the *oikoumene* appears" (Hahn 2001, 205), and so the nautical accounts in Homer prove essential to the

advancement of mapmaking. In fact, the paradigm presented on Achilles's shield, the circular cosmos framed by Ocean, may have inspired early efforts in Miletus to produce "scientific" maps.

## Miletus and Its Thinkers

Homer was thought to have lived somewhere in Ionia, the culturally Greek area of Asia Minor, perhaps not too far from Miletus, where Greek rational science was born and Greek mapmaking began. Early rational attempts to describe the earth, if not to map it, were abstract and theoretical. Along with other Greek cities in Asia Minor, Miletus benefited from numerous intellectual, economic, and cultural stimuli which fostered scholarly and rational activity. Until its destruction by the Persians in 494, it was a wealthy center of trade, in contact with the scientific and artistic achievements of the Near East and Egypt. Its citizens openly engaged in political debate. The laws they formulated were intended both to engender citizen consent and to express the political will of the majority; in addition, a widely disseminated and fully alphabetic script rendered the laws easily accessible.

The philosophical analog to political debate and open discussion is critical inquiry, which forms the foundation of rational science. As a vigorous center of commercial and colonizing activity, Miletus was likely a hub of varied geographic information circulated by sailors in port, and it was from this environment that geographic theory and empirical frameworks were developed. Early Greek terrestrial maps probably reflected both practical and abstract aims: to demonstrate the physical relationship between places as well as to prove a sense of order in the world and human (that is, Ionic Greek) control over that world order.

Early efforts to produce terrestrial maps lacked a strictly empirical tradition. In contrast, sky maps were developed from both abstract geometric principles and from direct observations of the risings and settings of stars, carefully recorded. Sky maps had both theoretical (cosmology) and practical (astrology and calendars) applications. Although early Greek cartographic initiatives in all likelihood derived from Babylonian and Egyptian traditions, the evidence for the transmission and reception of the relevant mathematical concepts is circumstantial at best. Only in the third century do the paths of transmission become securely detectable.[13] Otherwise, the earlier Greek evidence is either entirely lost or survives merely quoted without context in scant fragments.

### ANAXIMANDER

Anaximander of Miletus was not only the first Greek to be credited with drawing a map in the formal sense according to Eratosthenes, but he also engaged in broad intellectual pursuits and may even have founded a colony, perhaps on the Black Sea.[14] Among the geographic titles attributed to him are *Circuit of the Earth*, *On Fixed Stars*, and *Celestial Globe* (*Souda* A-1986). We cannot be certain of the content of these works or even of their existence. It is also debated whether Anaximander wrote a commentary on his map or on the construction of his celestial globe.[15] Even so, works with the titles cited, whether real or apocryphal, imply an informed preoccupation with both celestial and terrestrial cartography, and it seems credible that Anaximander was motivated to give a rational and critical account of the origin of the cosmos and the spread of human civilization. He believed that the same forces underlying the creation of the cosmos continued to guide it, and that these forces accounted for meteorological phenomena and climatic conditions.[16]

Anaximander's terrestrial map comprised an outline (*perimetron*) of the earth and sea; the late antique Greek geographer Agathemerus (ca. 400–600) adds that Anaximander "dared to draw" a map of the *oikoumene* on a *pinax* (tablet), a Greek word used both of painted panels and of bronze tablets.[17] It is impossible to reconstruct with any reliable accuracy either the map or even its shape and size, let alone Anaximander's written account. His treatise perhaps began with a cosmological introduction; then, by combining history, astronomy, and geography, it may well have proceeded in lecture format to discuss the arrangement of natural and man-made landmarks, cities, and climate as revealed in the pictorial map.[18] His geographic successors followed this approach.

Anaximander envisioned the world as a shallow but broad cylinder, its depth one third of its width, "like a stone column," hanging freely in the air, equidistant from other celestial objects. All scholarly reconstructions of his map envision a flat circle of earth surrounded by the stream of Ocean (fig. 3.2). His *oikoumene* was seemingly divided into thirds, namely, Europe, Asia and Libya, separated by the Nile and Phasis rivers and the Mediterranean Sea and Black Sea. There is no consensus regarding the relative sizes of the landmasses, let alone the map's center: Delphi, Delos, and Miletus have all been proposed. The shape of the *oikoumene* is further disputed. His map may have incorporated a three-point coordinate system, corresponding to the rising and setting of the sun on the days of the equinoxes and solstices.[19]

Anaximander is also said to have constructed a celestial globe, placing the earth at the center, following the pattern noted above on Achilles's shield. Anaximander devised ratios for relative distances between celestial bodies, placing the sun, equal in size to the earth, in a terrestrial orbit of twenty-seven times the diameter of the earth; the radius of the moon's orbit was eighteen times the earth's diameter, a progression of multiples of the number nine (fig. 3.3). The distance of the sphere of fixed stars, which he placed closest to the earth, was presumably nine times the earth's diameter. [20] The ratios of this celestial map have been connected to architectural proportions, and, intriguingly, Anaximander's approach to drafting both celestial and terrestrial maps may have derived from architecture.[21] Like an architect designing a temple, a cartographer would sketch a frame of the *oikoumene* on bronze or wood and build up his plan of the world from it. To both his cosmic and terrestrial plans Anaximander applied a tripartite division together with the rules of proportionality and symmetry which guided Mediterranean architecture, especially column drums; he is known to have compared the earth to a stone column. Clearly, his efforts were further guided by the practical applications of mathematics.

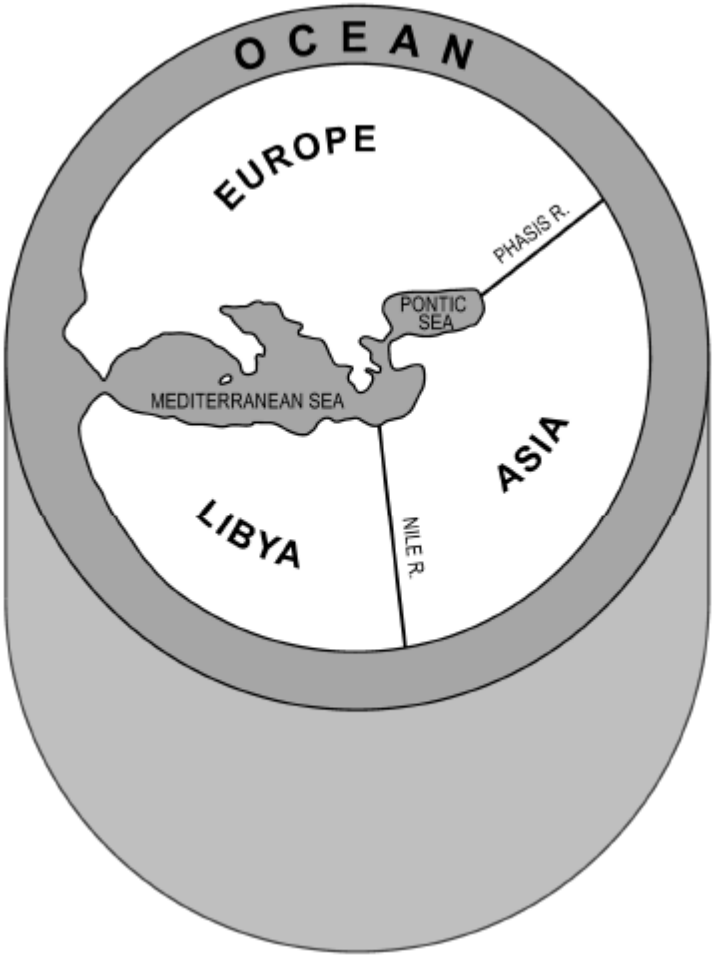



FIGURE 3.2 Anaximander's map of the earth. Reconstruction by the author.

**HECATAEUS**

Anaximander's fellow Milesian Hecataeus was the first Greek to produce a systematic written description of the world in his geographic treatise *Periodos* (or *Periegesis*) *Ges, Journeying around the Earth*. The surviving fragments suggest that he had traveled widely in Europe, Asia, and Africa. He may also have copied, or improved upon, Anaximander's terrestrial map; at least, Agathemerus proclaimed the new edition "more accurate so that it became a source of wonder."[22] Even so, rather than redrawing the map from scratch, Hecataeus perhaps just criticized his predecessor's work, in the typical way of Greek thinkers. Modern reconfigurations of Hecataeus's map closely resemble Anaximander's map. They show a circular earth, with Ocean surrounding the landmasses and the Mediterranean Sea in the middle (fig. 3.4). The *oikoumene* is depicted as tripartite: a strip of land lies to the north of the Mediterranean Sea (Iberia, Italy, Greece, and Asia Minor); another to the south (Egypt, Libya); and a third to the east (Palestine, Assyria, Persia, and Arabia). The lands to the north are the cold countries where dwell the mythical Hyperboreans (literally, peoples "of the far north"), separated from the rest of the world by the Rhipaean ("gusty") Mountains, whose location has always been a matter of debate. The lands to the south are the hot countries inhabited by the Ethiopians ("burnt

faced" because of their proximity to the sun) and the crane-fighting pygmies.

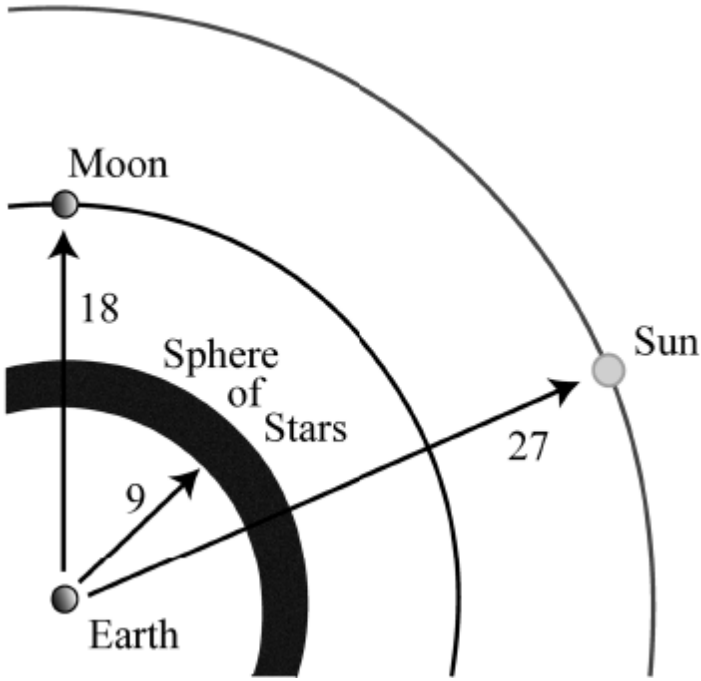



FIGURE 3.3 Anaximander's celestial map. Reconstruction by the author.

In short, this is a worldview that relies heavily on mathematical and ethnographic symmetry and balance, and mixes fact and fiction. Hecataeus's erroneous impression that the Hyrcanian (Caspian) Sea flowed into Ocean long persisted, and he also believed that the Nile arose from the southern Ocean. It is no surprise, by contrast, that he was particularly knowledgeable about the Black (Euxine) Sea, an area colonized by Miletus. He mentioned various Scythian peoples there, including the "black-cloaks." He described the flora of the Caucasus, including the thick forest cover and the native prickly artichokes, and he was aware of the varying topography (plain and mountain) of the Chorasmians' country in modern Uzbekistan.

FIGURE 3.4 Hecataeus's world map. Reconstruction by the author.

**ARISTAGORAS'S MAP**

A portable map commissioned by the ruler of Miletus, Aristagoras, was probably developed from those of Anaximander and his contemporary Hecataeus. Aristagoras used it when he toured the Greek mainland in 499–498 in search of supporters for a revolt against Persian rule.[23] The map was engraved on a bronze *pinax* like Anaximander's. According to the Spartans, Herodotus recounts, it was a circular "journeying around" (*periodos*), on which all the earth appeared along with all the sea and all the rivers. Herodotus represents Aristagoras showing it to the Spartan king Cleomenes with the following explanation (5.49):

The lands in which the earth's peoples dwell lie next to each other, as I shall show you: here are the Ionians, and here the Lydians, who inhabit a good land and have a great store of silver . . . and next to the Lydians you see the Phrygians, to the east, men that of all those known to me are the richest in flocks and in the earth's fruits. Close by them are the Cappadocians, whom we call Syrians; and their neighbors are the Cilicians, whose land reaches to the sea here, where you see the island of Cyprus located. The annual tribute which they pay to the king is 500 talents. Next to the Cilicians, here are the Armenians, another people rich in flocks, and after the Armenians, the Matieni, whose country is here; and you see the Cissians' land adjoining theirs; it is there, on this particular river the Choaspes, that Susa is situated, the residence of the Great King,

where his treasure-stores are.

On this detailed and informative map Aristagoras was able to show a vast swath of territory spanning mainland Greece, Ionia, and Persia. Even so, the map probably lacked any measurable scale. When Cleomenes inquired about the length of the march between Sparta and Asia, he was told "three months," a standard but ambiguous measure of the distance between places far apart.[24]

## Herodotus

Although there is no evidence to suggest that Herodotus included maps with his history, his ideas influenced the development of Greek cartography. He ridiculed circular maps which showed landmasses symmetrically divided by the Mediterranean Sea, and he doubted the existence of the Eridanus (Po) River, from which amber was thought to originate. As he discusses lands increasingly distant from the Mediterranean, the details become scanty, and his geography of the Indus is minimal (4.44). More generally, he raised several geographic questions: Why were three names (Europe, Libya, Asia) given to the earth, which is a single entity? Why were these landmasses all named after women? Who fixed the boundary of Asia and Africa at the Nile, and that of Asia and Europe at the Phasis River? (To Herodotus these boundaries were arbitrary.) Does water surround Europe to the west and north? Where precisely are the Cassiterides islands, the source of tin? What causes the Nile's annual flood?

To improve mapmaking, Herodotus gave precedence to data derived from empirical accounts. For example, he accepts that the continent of Africa ("Libya") is almost entirely surrounded by water (4.42), excepting the Isthmus of Suez, as proved by pharaoh Neco's circumnavigation of Africa (ca. 600). However, given the lack of empirical evidence that Ocean surrounds the contiguous landmasses of Europe, Libya, and Asia, he rejects this theory. Giving preeminence to data gleaned from exploration and travel, Herodotus attacks cartographers who utilized only geometry. His various criticisms imply a high, but repetitive, level of contemporary map production. Even if he did not use maps himself, his text can still be employed to produce an outline of the *oikoumene*. The framework is in place: there are limits to the extent of the world and boundaries between landmasses.

Herodotus was certainly forthright in his advice for drawing maps. He declares (4.36), "In a few words I will make clear the size [of Asia and Europe] and in what manner each should be depicted." He starts with Persia, delimited by the Persian Gulf and Arabia to the south. From the Black Sea are two peninsulas separated by the Phasis River: one arcs north to the Hellespont; the other extends south along the Red Sea to the Arabian Gulf and west to include Egypt and Libya. The Caspian Sea and the Araxes River delimit the extreme northeast, but east of India there is an uninhabitable desert whose topography is unknown. Libya is circumnavigable except where it borders Asia. But there is no certain knowledge of bodies of water delimiting northern Europe. Herodotus finds fault with cartographers for dividing Europe, Libya, and Asia into three roughly equal landmasses, "because the differences between them are great." He gives the length of Libya as 100,000 *stadia* and asserts that Europe is "as broad as Asia and Libya together." Altogether, with his preference for empirically derived data, he rejects the philosophical paradigm of cartography and aspires to some degree of topographical accuracy.

Like Homer, Herodotus includes cardinal directions and topographical landmarks:

bounding Egypt beyond Heliopolis, for example, are the Mountains of Arabia, oriented north to south and the site of quarries for the building of pyramids (2.8). Unlike Homer, Herodotus indicates approximate distances between places: the port of the Borysthenites lies at the midpoint of the Scythian coast (4.17); across from the Tanais River dwell the Sauromatae, whose lands stretch northward from Lake Maeotis (the Sea of Azov) and can be crossed in fifteen days (4.21); at its widest, Egypt is traversable in two months, whether by camel or on foot we are not told. Some distances in Egypt are given with deceptive precision: the seacoast reaches 60 "ropes" (*schoinoi*), or 3,600 *stadia* (2.6); the distance between the sea and the city of Heliopolis is reported as 1,500 *stadia*, only 15 *stadia* longer (he says) than the route between Athens and Olympia (2.7); and Heliopolis lies 4,860 *stadia* (81 *schoinoi*) up the Nile from Thebes, which is 6,120 *stadia* inland from the Red Sea (2.10). Nonetheless, despite his interest in geography and his unequivocal opinions regarding cartography, Herodotus utilized geography primarily to reinforce his presentation of history.[25]

## Democritus

Herodotus's contemporary, the widely traveled and creatively brilliant Democritus of Abdera (ca. 440–380) on the Aegean coast in Thrace, developed a theory of atomism and worked extensively in all areas of the mathematical sciences. He also wrote a *Description of the World*, now lost, which may have included a map.[26] We know that he gave considerable thought to the shape of the earth—perhaps in answer to Herodotus's criticisms of circular maps. He considered it to be a hollow disk sloping down ("inward"?) in the temperate hot southern regions because of the loose texture of the surroundings there, in contrast to the intemperate, frozen, congealed north. The southern terrestrial area, he thought, was weighed down by the accretion of vegetation.[27] Democritus proposed that the *oikoumene* was an oblong oval with a length-to-width ratio of 3:2; this ratio may imply ignorance of the Far East, but it influenced some later mapmakers.[28]

## Spherical Earth

The question of the earth's shape challenged many Greek thinkers, from Homer onward. Although the notion of a flat earth observed in the early maps and cosmographies of Anaximander and others was quickly abandoned, the symmetry and geographic determinism of the Greek mainland as the earth's center point nonetheless persisted, bolstered by philosophical and ethnic prejudices of Greek superiority. The Pythagoreans (ca. 450) at Croton in southern Italy, an area of extensive Greek colonization, may have been the first to suggest a spherical earth,[29] and the theory gained philosophical currency because the sphere was thought to be the "perfect" shape.[30] All parts of the cosmos were envisioned as spherical, and all celestial movements were explained as circular orbits or combinations of circles. In a neighboring region of southern Italy, likewise colonized extensively by Greeks, Parmenides of Elea (ca. 490–450) seems to have been the first to divide the spherical world into five symmetrically balanced zones (*klimata*): a hot zone at the equator, two temperate zones, and two cold.[31] He may have illustrated this division on a map or a globe (fig. 3.5). Henceforth, the sphere was taken as the orthodox shape of the earth. Plato (*Phaedo* 110b6) compared it to a leather ball made of twelve pentagons of different colors. Aristotle[32] subsequently proved the earth's sphericity from the evidence of lunar eclipses. As the moon wanes during an eclipse, it invariably retains a

curved shape: this is possible, he argued, only if the earth, whose shadow causes the eclipse, is spherical.

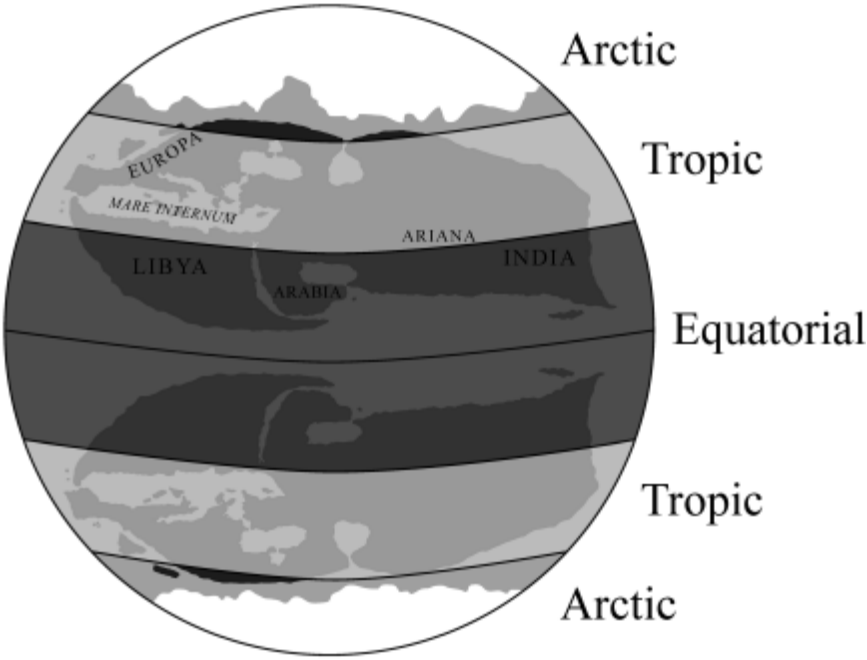



FIGURE 3.5 The spherical world divided into five symmetrically balanced zones (*klimata*). Drawing by the author.

To represent the earth on a three-dimensional sphere was impractical at best, and cartographers continued to employ a facile two-dimensional projection on papyrus, wood, or bronze. Furthermore, long after geographic inquiry confirmed that the *oikoumene* was greater in longitude than latitude, the circular paradigm endured. Echoing Herodotus, Aristotle (*Meteorology* 2.5.362b.13) deplored the way in which his contemporaries illogically continued to depict the *oikoumene* as circular. In his opinion such a representation was theoretically impossible given the sphere's geometry, and empirically impractical due to the ratio of the *oikoumene's* width to its breath. Much later, in the first century BCE, the Greek mathematician and astronomer Geminus[33] again complained about the artificiality of circular maps still in use in his own day that distorted relative distances.

## Fourth-Century Perspectives

Even so, by the fourth century maps began to show greater sophistication. Eudoxus (fl. ca. 365–340), a celebrated geometer and astronomer, composed a *Trip around the World* (*Periodos Ges*), of which only fragments survive. Strabo (9.1.2) praises his skill in rendering figures (*schemata*) and understanding latitudinal zones (*klimata*, based on the maximum hours of sunshine). Eudoxus's *schemata* imply geometrically informed maps designed to accompany his text. His determination that the *oikoumene*'s length is double its breadth became the simple and elegant ratio adopted by most Greek cartographers, including Geminus, who advised that "to draw a map to scale one should use a rectangular panel, with its length twice its breadth" (*Introduction to Phaenomena* 16.5–6).

Eudoxus's contemporary, the historian Ephorus (fl. ca. 360–330), recognized the value of geography to the historian. Only fragments of his work survive, but we know that—unlike Herodotus, who synthesized his discussions of geography and history—Ephorus presented an overview of the *oikoumene*. He treated world geography organically and in the order established by Hecataeus, starting from the Pillars of Hercules (Straits of Gibraltar) and working clockwise around the Mediterranean.[34] Ephorus's geographic interests included historical geography and the foundations of cities, and he also inquired into the theoretical geography of peripheral peoples. He viewed the earth as a flat rectangle, whose cardinal limits, cited according to the winds (Strabo 1.2.28), are represented by the Scythians (north), Indians (east), Ethiopians (south), and Celts (west). He believed that the two largest areas were Ethiopia, which extended from the sun's winter rising to setting, and Scythia, reaching from its summer setting to rising. We are further told by Cosmas Indicopleustes (fl. ca. 530–570), a Christian writer of the Byzantine period, that Ephorus illustrated his arguments "with the help of the enclosed drawings" (2.80). The illustration that Cosmas offers (fig. 3.6) shows a geometric figure keyed with the wind names and oriented (contrary to modern convention) with the north at the bottom (Boreas), east to the left (Apeliotes), south at the top (Notus), and west at the right (Zephyrus). The ecliptic (the sun's apparent orbit around the earth) crossed diagonally (from southeast to northwest), and the Aegean Sea was undoubtedly envisaged as the center.

With advances in theoretical cartography came debates about the extent of the inhabitable earth (*oikoumene*). Greek geographers doubted their ability to glean useful, let alone accurate, information about distant places. Plato (*Phaedo* 109b) speculated on the extent of the *oikoumene*. He posited that the Greeks, situated between the Phasis River (at the eastern end of the Black Sea) and the Pillars of Hercules, in fact inhabited only a small portion of the earth and were "living around the [Mediterranean] sea like ants or frogs around a marsh." He hypothesized that "many other peoples live in many other places." Aristotle, too, perceived a greatly restricted habitable range. Advancing Parmenides's division of the earth into five zones, he named the zones—equator, tropics, arctic circles—and compared each to a drum. He argued (*Meteorology* 2.5.362a.33) that the earth had two habitable zones, the one where we (Greeks) dwell, toward the upper pole, and a corresponding one toward the lower pole. The upper zone of the *oikoumene* extends from the Pillars of Hercules to India and from Ethiopia to Lake Maeotis (the Sea of Azov), a ratio exceeding 5:3. Excessive heat and cold prevent habitation, and even exploration, to the north or south; Ocean between the Pillars of Hercules and India interrupts the habitable stretch of land and "prevents it from forming a continuous belt around the globe." Aristotle's view gained currency.

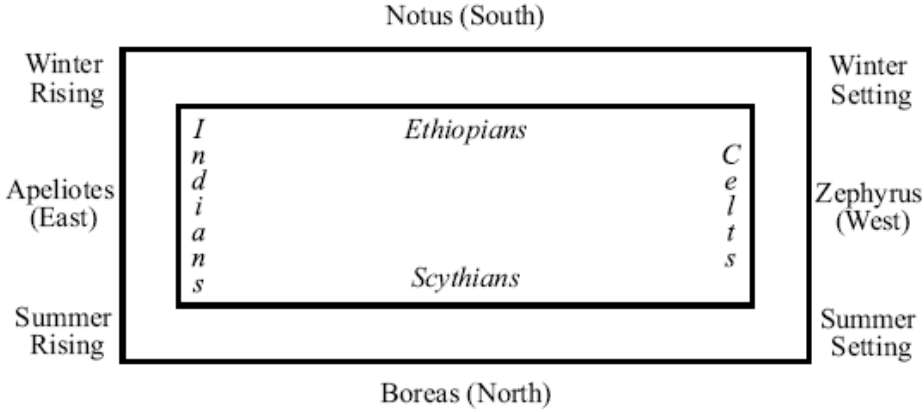


FIGURE 3.6 Ephorus's flat earth. Drawing by the author.

Although philosophy continued to guide mapmaking initiatives, a trove of fresh empirical data was acquired during the rule of Aristotle's famous student, Alexander the Great of Macedon, as well as in the scientific "golden age" immediately following his death. Theories and mathematical models came to be correlated with a growing body of facts about the world. Alexander was passionately eager to explore the entirety of the *oikoumene* east of the Aegean, and he endeavored to extend Greek culture as far east as the Punjab. Scholars in numerous disciplines accompanied him: biologists, zoologists, physicians, historians, geographers, and surveyors. They were instructed to collect data and to produce full records of their observations. From this endeavor there survive fragments of a *periplous* of the Black Sea (and probably beyond) written by the historian Callisthenes, as well as of two accounts of Alexander's expedition to India by his admiral Nearchus and helmsman Onesicritus.[35] Eumenes of Cardia recorded daily reports of the king's travels. Baito and Diognetus, professional road surveyors, were retained to measure distances between stops, and they also made notes of local geographic features, including topography, soil, flora, and fauna (Pliny, *NH* 6.61.4). Alexander's ambitions to explore the Far East were thwarted only by his mutinous troops. Nonetheless, for centuries afterward geographers continued to draw from the information gleaned during his expedition, and these new data were soon employed to draw maps of Asia and to complete the contours of the *oikoumene*.

Alexander's contemporary Pytheas (fl. ca. 320–305) is in turn significant for extending geographic knowledge of western Europe, especially the coasts along the English Channel, and for his use of astronomical observations to compute latitudes. A navigator and astronomer from the Greek colony of Massalia (Marseilles), he explored the Ocean west of the European mainland and recorded his journey and observations in *On the Ocean*, now lost but quoted and criticized by Strabo. Pytheas's claim to have explored "in person" the entire northern region of Europe "as far as the ends of the world" met with disbelief; Strabo accused him of shameless mendacity.[36] Nonetheless, other writers used his observations. Most modern scholars agree that his journey in fact occurred, yet there is no consensus regarding its date or route or scope—perhaps reaching to islands north of Scotland, to Norway, to Jutland, or even to Iceland (fig. 3.7).

Pytheas sailed from Massalia through the Pillars of Hercules up the Iberian coast to the "Tin Islands" (Cassiterides, whose location is contested) and across to Britain; next probably the east coast to Scotland, its Northern Isles, and the island of Thule; then back east to the Baltic, where he found the source of amber on the island of Abalus. He

described Britain as a triangle, and with reasonable accuracy he estimated the island's circumference at more than 40,000 *stadia*, a length considered excessive by Strabo but accepted by Eratosthenes.[37] Using a gnomon (the part of the sundial which casts the shadow), Pytheas calculated the latitudes of Massalia and other places he visited. He observed that the summer solstitial day lengthened as he ventured northward, and he may have been the first to connect latitude to the duration of a place's solstitial day. At a place 9,100 *stadia* north of Massilia (Mona, the island of Anglesey?), he observed that the winter solstice sun rose only to 6 cubits (12 degrees) and that daylight on the summer solstice lasted nineteen equinoctial hours.[38]

Describing Thule as a place where land, sea, and air lose their distinctive properties —"congealing together in substances resembling a sea-lung [probably comb jellies], upon which one can neither walk nor sail"—Pytheas observed (or theorized) that this island was the northernmost point of the British chain, where "the circle of the summer tropic is the same as the arctic circle."[39] He knew from the geometry of the sphere that there must be some point on the globe where the sun would shine for a full day at the summer solstice. He also noted that the amplitude of ocean tides depends on lunar phases, and that the celestial North Pole is marked not by a single star, Polaris, but rather by a rectangle of Polaris together with three faint stars.[40]

While there is no record that Pytheas produced a map, both his theoretical approach and his assemblage of data greatly advanced the science of cartography. Pytheas creatively exploited the abstract and precise language of mathematics and astronomy together with a mass of carefully gathered empirical evidence. He extended Greek knowledge of the geography of the European northwest and, despite Strabo's scorn, laid the foundation for incorporating parallels of latitude into maps.

FIGURE 3.7 Pytheas's travels. Map by the author.

A contemporary of Pytheas who, in contrast, gained recognition for making a significant contribution to cartography was Dicaearchus of Messana in Sicily (fl. ca. 340–290). A polymath who studied under Aristotle at Athens, he established the foundation of a coordinate system by imposing onto the *oikoumene* an axis with a meridian (through Rhodes) and a parallel, or line of latitude (*diaphragma*), extending from the Straits of Gibraltar, through Sicily, and along the Taurus Mountains to Mount Himaeus (in the Himalayas). For this advance, he was ranked by Strabo (1.1.1) alongside Democritus, Ephorus, and Eudoxus. He described the *oikoumene* in his lost *Trip around the World* (*Periodos Ges*), which was probably accompanied by a map. Following Democritus, Dicaearchus adopted the ratio of 3:2 for the *oikoumene*'s extent (fig. 3.8). He reported distances between certain places and measured the heights of mountains, which he then compared with the size of the *oikoumene* to show that they did not significantly affect the earth's sphericity.[41] In addition, he correctly oriented the eastern extent of the Taurus Mountains along an east-west coordinate, instead of diverting them to the north, as had

earlier Greek geographers.

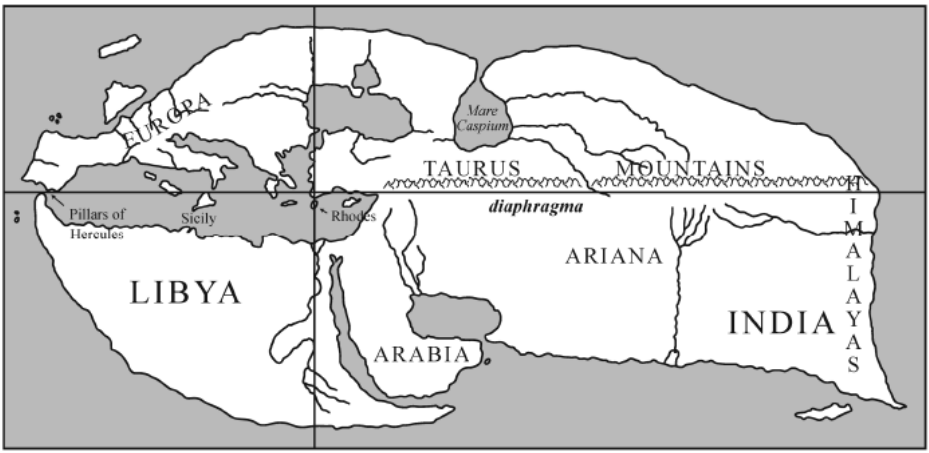



FIGURE 3.8 Dicaearchus's world map. Reconstruction by the author.

## The Museum at Alexandria and Its Director, Eratosthenes

Although neither maps nor texts survive intact, it is clear that after Alexander Greek cartography of the *oikoumene* changed markedly in methodology, scope, and accuracy. The "Museum" at Alexandria, a center of learning founded by Ptolemy II Philadelphus (ruled 285–246), served as the central meeting place for Greek-speaking scholars of nearly all disciplines; it was also a conduit of learning from the east. The scientific documents collected for the Museum's library proved instrumental in codifying cartographic and geographic knowledge and in fostering advances in mathematics, astronomy, and geography during the third century. It was at the Museum that Aristarchus (ca. 280–270) shockingly proposed a heliocentric model of the universe, envisioning that the earth revolved around the sun and that it was not, after all, at the center of the cosmos. Availing himself of the Museum's resources, Hipparchus (fl. ca. 140–120) detected the precession of the equinoxes, observing that the stars were indeed not "fixed" and motionless; rather, like a very slow spinning top, they made a gradual rotation about the earth's axis every twenty-five thousand years.

The polymath Eratosthenes of Cyrene directed the Museum's library for forty years (ca. 245–205) and in this position helped to advance Greek theoretical cartography to its acme (Geus 2002). In particular, his world map and his estimate of the earth's circumference were enduring. He had studied at Athens with Stoic and Academic philosophers, including a student of the mathematician Autolycus (fl. ca. 300 BCE), whose works *On Rotating Spheres* and *On Risings and Settings* focus on sphere geometry. Under such influences Eratosthenes composed his two geographic treatises, both now lost, *Geographica* and *Measurement of the Earth*, the latter explaining his process for determining the earth's circumference.

For this purpose, Eratosthenes used astral data together with a simple and elegant ratio based on the geometry of the sphere: he assumed that the earth was a perfect sphere.[42] Ascertaining that two Egyptian cities, Syene (modern Aswan) and Alexandria, lie on the same meridian (see fig. 2.1), Eratosthenes compared readings from both on the day of the summer solstice, at high noon. At Syene no shadows were cast at that moment

because the sun was precisely at its zenith, but a slight shadow was cast at Alexandria, because of the curvature of the earth and Alexandria's higher longitude. Eratosthenes assumed that the sun was infinitely distant, so that its rays were parallel everywhere on the earth. He then measured the angle of the shadow cast at Alexandria as one-fiftieth of a circle (see fig. 3.9). This angle was equal to the angle subtended at the earth's center, and the length of arc between Syene and Alexandria was approximately 5,000 *stadia*. Eratosthenes multiplied the latter figure by fifty (the number of units in his circle) to find the earth's circumference: 250,000 *stadia*, in other words 39,375 km = 24,412.5 miles if we credit that he employed the Egyptian *stadion* noted above (= 157.5 m). In fact, this result is remarkably close to today's estimate of 40,076 km (24,901 miles). Eratosthenes later adjusted his figure to 252,000 *stadia* (39,690 km = 24,608 miles), a number divisible by sixty. Then, after dividing the earth's circumference into sixtieths—yielding intervals of 4,200 *stadia* each—he imposed dimensions onto Parmenides's zones of latitude: eight sixtieths (33,600 *stadia*) for the torrid zone, seven (29,400 *stadia*) for the two temperate zones, and four (16,800 *stadia*) for the frigid zones.

The theoretical and empirical advances noted in the *Measurement of the Earth* were further expanded in Eratosthenes's *Geographica*, a work in three books, known primarily through Strabo's direct citations of it and Hipparchus's criticisms. The term *Geographica* was possibly coined by Eratosthenes to imply "world cartography," reflecting the new rational, quantitative, and scientific trends in mapmaking. In this work Eratosthenes discussed the history of Greek geographic scholarship (significantly omitting Homer from his list of predecessors), and he took up the debate regarding the dimensions and shape of the *oikoumene*. He compared its shape to the short Macedonian cloak, the *chlamys*, a curving trapezoid tapering at its lower edge.[43] Assuming a spherical earth "with certain irregularities of surface" (Strabo 1.3.3), he placed the *oikoumene* entirely north of the equator, between the Cinnamon country in the south and Thule in the north (a span of 37,600 *stadia*), the Pillars of Hercules in the west, and the Taurus Mountains in the east (a span of 76,000 *stadia*). The ratio is nearly 2:1. He expressed latitudes with regard to distances north of the main parallels—the equator ("Cinnamon country"), and then those marked by four important cities (south to north): Meroe (in modern Sudan), Syene, Alexandria, and Rhodes. His meridians may have included Europe's western capes, the Pillars of Hercules, Straits of Messana/Carthage, Rhodes/Alexandria, Issus, Caspian Gates/Persian Gulf, and the Indus River.[44] The result is a rough coordinate system.

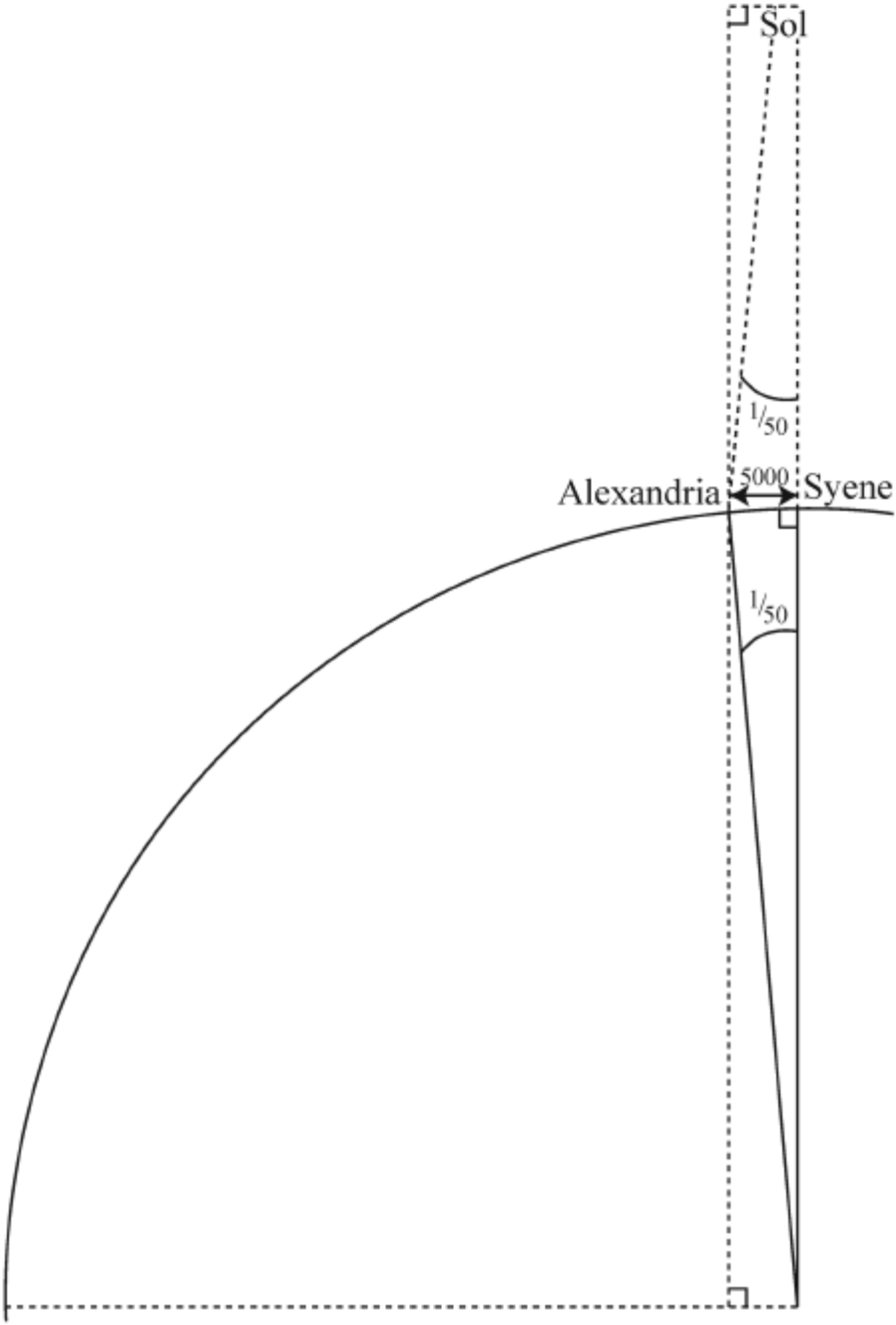



FIGURE 3.9 Eratosthenes's calculation of the circumference of the earth. Drawing by the author.

In the third book of his *Geographica*, Eratosthenes guided readers in envisaging a map of the *oikoumene* (fig. 3.10). Building on Dicaearchus's *diaphragma* and rejecting a division of landmasses only by bodies of water, he split the *oikoumene* into two equal halves, with a parallel from the Pillars of Hercules to the easternmost limit of the Taurus Mountains; hence, Dicaearchus's symmetrical axis was reinforced (Strabo 2.1.1).

Eratosthenes then subdivided his northern and southern halves into "seals," or *sphragides*, irregular quadrilateral shapes resembling document seals. Thus, India was rhomboidal, bounded by oceans on two sides, by the Taurus Mountains to the north and the Indus River to the west; Ariana was a parallelogram delimited by the Caspian Sea, the capes of Carmania (in southern Iran), and the Persian Gulf.[45] Eratosthenes divided his northwest region, Europe, on the basis of three promontories projecting into the Mediterranean: the Peloponnese, Italy, and the Ligurian "promontory" of Corsica and Sardinia. Even though his excessive generalizations were later subjected to harsh criticism by Hipparchus (see below) and Strabo, his *sphragides* still represent a concerted effort to compartmentalize, categorize, and impose order on the *oikoumene*. It is not certain whether he drew a map to accompany his text, although Strabo (2.1.2) implies that he did. Nonetheless, his theories regarding the shape and deployment of the *oikoumene* provided the standard paradigm of both textual and pictorial maps well into the Roman period, a trend which culminated in Ptolemy's *Geography* (see chap. 4 below).

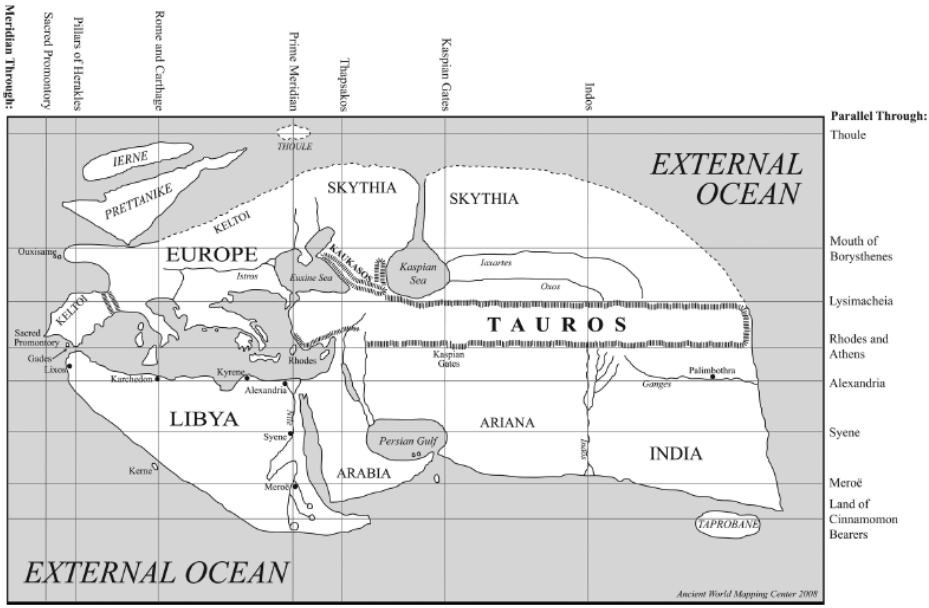



FIGURE 3.10 Eratosthenes's world map. Reconstruction reproduced from Duane W. Roller, *Eratosthenes' Geography*. Princeton University Press. Reprinted by permission of Princeton University Press.

## Hipparchus

Hipparchus (fl. ca. 140–120) was primarily an astronomer and mathematician with a strictly theoretical and mathematical interest in geography. He was deeply critical of Eratosthenes's regard for descriptive geography and of the inconsistencies in his measurements.[46] In fact, it may have been Eratosthenes's sloppy arithmetic that provoked Hipparchus to write his treatise bluntly entitled *Against the "Geographica" of Eratosthenes*, now lost except for sparse quotations by Strabo. After double-checking Eratosthenes's distances between places and discovering incongruities and arithmetical impossibilities—the numbers simply do not add up—Hipparchus next examined Eratosthenes's geographic hypotheses and postulates, and then criticized his methods, in

particular reliance upon ambiguous and generalized evidence and use of theory without any factual basis.[47] Even though Eratosthenes's method of estimating the earth's circumference and the resulting value met with approval, Hipparchus asserted that contemporary geographic practices were sorely inadequate for making a new world map. In Hipparchus's view, geography must be advanced on strictly mathematical and astronomical grounds, and the arbitrary distances reported by merchants and travelers who lacked rigorous mathematical training were useless (Strabo 1.1.12).

Hipparchus connected terrestrial locations to celestial phenomena, demonstrating that it was possible to develop a mathematically robust system of real map projections on grids of parallels and meridians, with some points fixed by the stars. Solar and stellar observations give estimates of latitude with reasonable accuracy, as Pytheas had shown, and simultaneous eclipse observations could yield similarly reliable longitudes, provided that such observations were communicated and correlated. Even so, the data for longitudes remained inadequate or nonexistent. Hipparchus made it easy for the layman to find latitudes, however, by including astronomical tables in his third book; these tables recorded data calculated for several of the parallels between the equator and North Pole.[48] With knowledge of the earth's circumference, and an understanding of spherical geometry, one could estimate the circumference of any terrestrial parallel or meridian, a system of coordinates could be established, and distances could be calculated trigonometrically.[49]

Hipparchus rejected many of Eratosthenes's distances on methodological grounds, but he failed to take into account the increase in geographic knowledge resulting from Alexander's conquests. He especially criticized Eratosthenes for distorting the eastern portion of the *oikoumene*, accusing him of placing India too far south, for example.[50] Instead, Hipparchus erroneously adhered to the old Ionian map paradigm for the Far East, but he was right in correcting Eratosthenes on several points regarding the topography of the western Mediterranean.[51] Among Hipparchus's enduring contributions to Greek cartography was his call for a scientific and mathematical approach based on trigonometrical determinations of latitude and longitude. His own idealized and theoretical approach might have proven more productive in the early years of the Museum at Alexandria if only geographic theory and data had advanced sufficiently by the early third century. Changing political conditions, however (including the advance of Rome), prevented long-term scientific research. Furthermore, the educated elite strongly favored descriptive and political geography, to the exclusion of mathematically informed studies.

## Conclusion

Maps are an important expression of Greek culture. In their shape and deployment are embedded social, cultural, and political prejudices: the superiority of Greek over non-Greek, of one city-state over a rival. Cartographic data were derived from political, commercial, and military sources, and successive advances came in the wake of increased interaction with other peoples in the Mediterranean and beyond. The flat-earth theory and Anaximander's column drum map were abandoned for a spherical earth organized into zones of latitude as set by Parmenides and advanced by Aristotle and Eratosthenes. Anaximander's vision of a circular and tripartite landmass grew into a complex conception of lands arranged and ordered by a scientifically informed system of coordinates, as found in Pytheas, Eratosthenes, Hipparchus, and, later, Ptolemy. The

philosophy of symmetry was never entirely abandoned. Descriptive maps were included in a wide variety of writings. Maps were never primarily intended just to show precise spatial relationships between places. Early Greek maps, in particular, had no practical application, but they stimulated the imagination and enriched Greek ideas about humans' relationship to the natural world; they also reflected the Greek zest for adventure and exploration. Ultimately these maps and their successors served to impose order and reason upon the physical landscape.

# FOUR

## Ptolemy's Geography: Mapmaking and the Scientific Enterprise

**Alexander Jones**

A copy of Ptolemy's *Geography* from before the sixteenth century, whether it is a Byzantine codex containing the original Greek text, a western European manuscript in Latin, or a printed book, stands a good chance of being an extraordinarily luxurious object, containing a set of beautifully executed maps following a recurring pattern: one map showing Europe, Africa, and Asia, and twenty-some showing individual regions of these continents. The regional maps, always in the same order, work their way from the westernmost parts of Europe eastwards, then through Africa, and lastly across Asia, again from west to east, coming to an end with central China, southeast Asia, and Sri Lanka. The maps are the most eye-catching items in these books, although in fact many more pages are devoted to text, copied out or printed either in the original Greek or in Latin translation, and mostly consisting of names of places and numerals laid out in a more or less tabular format: a rebarbative, scarcely readable gazetteer.

It is a quirk of literary history that a book dating from the second century of our era and consisting mostly of such dry-as-dust lists should have been among the most prized of articles in fourteenth-century Byzantium and fifteenth-century western Europe. What made this possible for Ptolemy's *Geography*, of course, was the maps; for these were no mere ornaments, but showed practically as much of the world as was known to Europeans at the brink of the Age of Discovery, albeit the world as it had been peopled one thousand years and more before. No doubt Ptolemy would have been astonished that in all this time his work had still to be superseded, or at least brought up to date, but, if nothing else, it should have pleased him to know that his project had *worked*.

The *Geography* is, on the face of it, a very practical book, as its full title, *Geographical Guide*, makes evident. Its intention is to provide the reader, or it would be more accurate to say, the *user*, with everything that he or she needs to construct a map of the known part of the world. And it is very effective in attaining its object: equipped with a copy of the *Geography*, anyone living anywhere at any period who followed Ptolemy's instructions with care would produce substantially the same maps.[1] Behind this practical approach, however, are many theoretical presuppositions, not just such immediately relevant ones as the shape of the earth, but ones that go to the heart of what science is for and how it works. Ptolemy is explicit, but terse, about these assumptions in the *Geography*; it is only when we read it together with his other scientific writings that the depth, coherence, and distinctiveness of his approach become fully apparent. In short, to understand Ptolemy in his role as a cartographer, we must consider him as a scientist and philosopher.[2]

### Ptolemy's Cosmology and Science

The subjects of Ptolemy's books are disparate. He wrote on the principles governing the

pitches employed in music, on the process of vision and the relationship between what we see and what actually exists in the external world, and on categorizing and predicting the physical effects that the heavenly bodies exert on our environment and on our individual lives and characters; in addition, he wrote half a dozen works on astronomy.[3] Two concerns come up over and over again in these writings: how do we, or rather how *should* we, acquire the best possible knowledge of aspects of the world around us, and how should we present this knowledge, whether in graphic or pictorial form or by other means? Practically all Ptolemy's works address one or other of these concerns. Some involve both; in the *Geography* they have roughly equal prominence, as he discusses in turn how best to obtain the data for a map and how best to draw one. In fact, for him the problem of presenting or representing knowledge is really a manifestation of the epistemological problem, since the chief purpose of his modes of presentation is to impart knowledge to other people.

While historians of cartography of course know Ptolemy for the *Geography*, historians of science are most likely to be acquainted first and foremost with his astronomical works, above all with the *Almagest*, the treatise in which he deduces a detailed system of theories to explain—and allow predictions of—the apparent movements and other phenomena of the sun, moon, stars, and planets.[4] Now most of the *Almagest*, and indeed most of Ptolemy's other works on astronomical topics, consists of technical, rigorous, mathematically structured science free of terms that we would associate with philosophy. The *Geography*, while less mathematically challenging, also eschews the jargon of philosophy. Hence many people do not realize that Ptolemy had a very solid grounding and deep interest in philosophy—that in fact, like his contemporary in medicine Galen, he can claim to have been one of the most important philosophers of the second century CE.[5] This side of Ptolemy shows itself outwardly in the *Harmonics*, the *Optics*, and the astrological *Tetrabiblos*, where philosophical terminology and concepts are inextricably entwined with technical science, and in the *Criterion*, a monograph on epistemology that makes no explicit reference to scientific problems.[6] It is present in the *Almagest* and *Geography* too, but latent.

Perhaps the most direct entry to Ptolemy's philosophy is by way of his geocentric cosmology, which is something about Ptolemy that "everyone knows," and for once what everyone knows is reasonably accurate—up to a point! To him, the cosmos is, for all intents and purposes, an immense but finite sphere; what, if anything, lies beyond the outer surface of the sphere he nowhere speculates. The cosmic sphere has two distinct parts. At its center is an inner sphere, composed of the four elements earth, water, air, and fire, which are more or less stratified from the heaviest at the center out to the lightest around the outer surface of this inner sphere. We, of course, live upon those parts of the surface of the earthy mass that are not covered by water. Enclosing this domain of the four elements is a spherical shell, composed of a fifth element, aether, which is lighter than the other four and, unlike them, is not liable to transformation or alteration, generation or decay. The aetherial shell is not a single body, but has a number of distinct pieces, one enclosing another, shaped in such a way that the pieces can slide against one another freely in various kinds of rotation. Most of this aether is invisible, but some parts are either visible or luminous, and these are in fact the stars, planets, moon, and sun. The moon and the bodies of transparent aether connected with it are innermost, whereas the stars and their aetherial setting are outermost.

Where the popular idea of Ptolemaic cosmology often goes astray is with respect to its dimensions. When we make diagrams to show the layout of Ptolemy's cosmology, we

usually assign sizes to its parts in such a way as to make everything visible, and the result is that the earth beneath our feet looks fairly significant on the cosmic scale. But when Ptolemy wrote the *Geography*, he had already concluded that the boundary between the fiery periphery of the four-elements part of the cosmos and the aetherial shell was thirty-three times as far from the center of the cosmos as the surface of the solid earth, while the sun—which is by no means the furthest object in the cosmos—was 1,210 earth radii from the center. Eventually, though this may have come after the composition of the *Geography*, Ptolemy worked out a complete scheme of cosmic distances, according to which the distance from the center to the outermost surface of the aetherial shell was close to six hundred times the distance from the center to its inner surface, and twenty thousand times the solid earth's radius (fig. 4.1).[7] Thus the portion of the cosmos allotted to the four elements was a mere speck relative to the whole, and our earth was a speck within that speck (fig. 4.2).

The cosmic insignificance of the terrestrial globe (with us on it) is not just a matter of relative bulk. Ptolemy believes that the cosmos as a whole, like an individual human being, has an intellective soul with a governing faculty, a *hēgemonikon*, in the jargon of the Hellenistic philosophers, that drives and coordinates the movements of its parts with exquisite rationality. And this governing faculty does not reside at the center, the "bottom" of the cosmos, any more than a human soul resides in the soles of one's feet: its seat is at the top, the outer periphery of the celestial sphere.[8]

FIGURE 4.1 Diagram of the heavenly spheres from Peter Apian, *Cosmographia* (Antwerp, 1540), a typical schematic representation of an early modern European version of Ptolemaic cosmology. The innermost three spheres are the "solid" earth (elemental earth and water), air, and fire. The Newberry Library, Gift of Edward E. Ayer. Reproduced with permission.

It is commonly supposed that the physical framework of Ptolemy's cosmology—with

its discontinuity between the sphere of the four elements and the celestial shell of aether —was ultimately traceable to Aristotle, which is true, and that it was the conventional cosmology of Greek antiquity, which is false. Within his own Peripatetic school, Aristotle's theory that there is a celestial fifth element was received at best with doubt and at worst with hostility. Stoics and Epicureans, who agreed on little else, agreed that the heavens were composed of the same materials as our immediate environment, though in different proportions. So, initially, did the so-called Middle Platonists, starting with Antiochus of Ascalon, notwithstanding their reliance on Aristotle's works as a window on Platonic verities.[9] However, it was not long before Ptolemy that some Middle Platonists, such as Adrastus of Aphrodisias and Theon of Smyrna, embraced the five-element cosmology and adapted it to render it more compatible with recent astronomical theories, according to which heavenly bodies vary in their distance from the center of the cosmos.

Ptolemy was not a Middle Platonist in the narrowest sense, but his idiosyncratic brand of Neoaristotelianism is best understood as an offshoot of that tradition; what is more, he seems to assume that his readers will already be committed to a cosmology incorporating the aetherial fifth element and the discontinuity between the sublunary and superlunary regions. For him it is axiomatic that the only temporal processes conceivable in the heavens are spatial motions of the aetherial bodies, and these motions must be limited to unhindered spinning that goes on with perfect regularity through eternity. Our lower world of earth, water, air, and fire, on the other hand, is characterized by perpetual but irregular changes involving qualities as well as spatial positions.

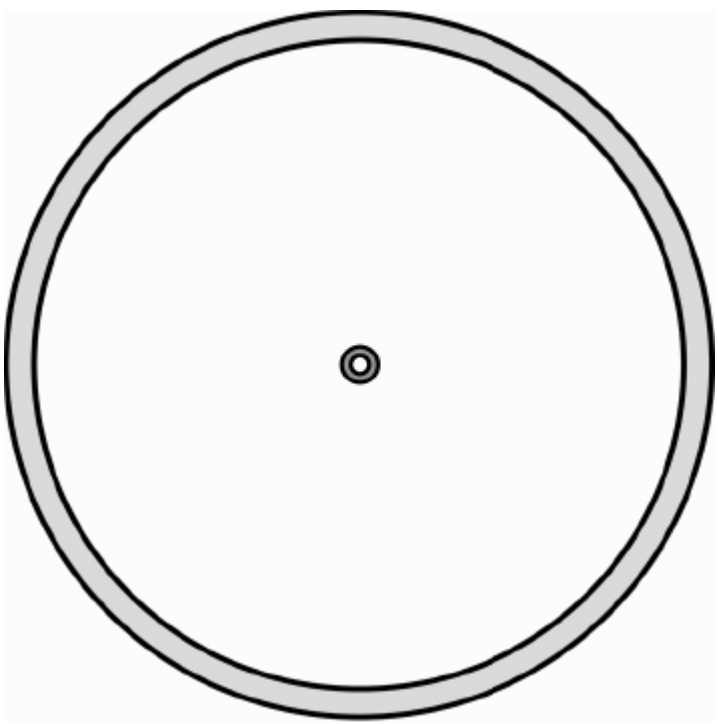


FIGURE 4.2 The cosmic dimensions of Ptolemy's *Almagest* represented to scale. The outer ring represents a cross section of the spherical aetherial shell comprising the sun and the invisible bodies that govern its motion. The inner, dark gray ring represents a cross

section of the shell for the moon. The white space within this ring is the sphere of the four mundane elements. The solid terrestrial globe at the exact center, with its diameter less than a thousandth of the diameter of the solar shell, is too small to portray. According to the theory of Ptolemy's later *Planetary Hypotheses*, the space between the lunar and solar shells is filled by shells for Mercury and Venus, while the solar shell is enclosed by shells for the remaining planets and the fixed stars. The diameter of the outermost shell is nearly 170 times the diameter of the solar shell. Drawing by the author.

This physical cosmology underpins Ptolemy's conception of science, which he delineates in the opening chapter of the *Almagest* and book 3 of the *Harmonics*. Consider an object in our sublunary world, compounded of some or all of the four mundane elements. It has certain attributes, some of them essential to its nature and some contingent on its situation with respect to other things. For instance, a lump of strawberry ice cream has attributes such as coldness, sweetness, moistness, and pinkness, as well as a certain shape and volume, which are partly determined by the shape of the bowl, and it is so many feet away from us and is being carried towards us at a certain speed by a waiter. So much for the objective, external reality. Our perception of the ice cream, which is the foundation of any knowledge we have of it, is coming at this stage through our sight alone; only later will touch and taste and smell come into play. Now, our faculty of sight can register one kind of attribute directly, namely color, though together with this detection of the pinkness it is aware of the directions from the eye in which the pinkness lies as well as, to a limited extent, the distance. Hence by means of the color, the sight indirectly perceives attributes such as size, shape, position, and motion.

So far all this is straight out of Aristotle's theory of sense perception. Ptolemy, however, introduces a new twist by observing that the qualities that our senses directly apprehend, such as color, hot or cold, sweet or sour, are associated with the irregular processes of change and transformation to which the four elements are subject. Because they are irregular, exact generalized knowledge of them is unattainable. On the other hand, the attributes that are perceived by way of the directly sensed qualities—size and shape, number, position, and motion—can be reasoned about using the methods of mathematical demonstration, and thus are knowable. Even so, this knowability is subject to two limitations. First, since the qualities are perceived only by way of the irregular attributes such as color, an element of unknowability or uncertainty adheres to any observation or experiment. Second, the object that we are studying is itself mutable because of the inherent instability of its constituent elements.

The aetherial bodies in the heavens, by contrast, are immutable. Hence any knowledge we can obtain of them through our sight (the only sense faculty that can perceive them at all) has a permanence that is impossible for mundane objects. A certain degree of imprecision is unavoidable in our perceptions and resulting knowledge of the heavenly bodies, arising from the fact that these perceptions must take place through the mediation of our unstable bodies and the unstable surrounding air or other matter. Thus for Ptolemy there is a hierarchy, beginning with the lowest level of unreliable, probabilistic knowledge (or as he once calls it, "guesswork"), to which we are limited concerning the qualitative attributes of mundane bodies; then ascending first to the valid though unstable knowledge we can have of the quantitative attributes of mundane bodies, next to the secure albeit slightly fuzzy knowledge we can have of the attributes of heavenly bodies; and finally to a secure and perfect knowledge of the heavenly bodies

that no human being can attain. All the first three kinds of knowledge, however, are aimed at in Ptolemy's works. His designation for the lowest kind is "physics," and it provides the causal framework for the astrology of his *Tetrabiblos*. The others he calls "mathematics." His *Harmonics* is an exercise in the mathematics of mundane objects, the relations among musical pitches made by human voices and instruments. The *Almagest* is celestial mathematics.

In Ptolemy's view, a human being acquires knowledge not passively through an automatic process arising from sense perceptions, but by judgment exercised by reason cooperating with sense perceptions. In other words, it is a way of thinking that one must acquire, and one can do it in a wrong way or in the right way. In scientific contexts such as harmonic theory and astronomy, one must have an appropriate strategy involving successive approximations: an initial sense perception provides reason with a basis for setting up conditions under which further sense perceptions can yield more exact information. In other words, Ptolemy's scientific methodology relies on progressive stages of experiment, each of which presumes and seeks to refine a preexistent theory that ultimately can be traced back to certain naive but unambiguous sense perceptions.[10]

Wherever possible, Ptolemy's preferred form of reasoning is mathematical deduction from reliable empirical data. When confronted with questions that cannot be settled directly in this way, Ptolemy accepts other types of reasoning of a more metaphysical or dialectical character, among which the two most important are analogy, the assumption that structures and relations in nature tend to follow similar patterns in different contexts, and simplicity, the assumption that structures and relations tend to be the least complex ones that are compatible with the phenomena. Underlying these arguments is Ptolemy's confidence that a fundamental orderliness, rationality, and goodness subsist in the cosmos.

## Ptolemy and the Greek Cartographic Tradition

While Ionian Greeks were said to be making maps representing the world already in the sixth century BCE, a genre of texts that offered a rational and critical argument for the layout and content of a world map began only in the third century with Eratosthenes's *Geographica*. As the previous chapter has shown, through the geographer Strabo we gain some insight into this work, as well as into the treatise that Hipparchus composed about a century later to castigate its author's faults. The next author of works along the same lines as Eratosthenes's is Marinus of Tyre, who was active around the first decade of the second century of our era. It appears doubtful that the gap of more than two centuries between Hipparchus and Marinus represents a total lapse of this kind of research and writing. We should keep in mind that we would not know that Hipparchus wrote a polemic against Eratosthenes were it not for a single surviving witness, Strabo, and again that the very existence of Marinus would have been forgotten if we did not have Ptolemy's *Geography*. It is in fact the only instance of this genre of cartographic literature to have come down to us—so tenuous are the threads on which hangs the remembrance of ancient scientific writers.

In the *Geography* Ptolemy assumes the stance of a reformer coming to the cartographic tradition from outside; and like a reformer, he begins with fundamental issues.[11] At the outset he offers a definition of the subject of the book: *geōgraphia* is an imitation, a *mimēsis*, of the known part of the world by means of drawing. This may appear a strange definition to us, since we tend to think of the word *geōgraphia* as equivalent to our term

"geography," which is how Strabo uses it. But Ptolemy is actually adhering to an older tradition, going back to Eratosthenes, who may have coined the word and who evidently meant it to signify mapmaking.[12]

Immediately, however, Ptolemy refines his definition by contrasting *geōgraphia*, the pictorial imitation of the whole known world, with something called *chōrographia*, a pictorial imitation of smaller regions. This does seem to be an innovation of terminology, since both before and after Ptolemy the accepted meaning of *chōrographia* is a *text* describing geographical regions, and such a text could in fact cover the entirety of the known world. I believe that Ptolemy is not only inventing a new meaning for *chōrographia*, but also introducing for the first time the contrast that he wishes to delineate between two kinds of mapmaking. He is not describing what the mapmakers up to his time actually did, but what they *should* do.

Ptolemy's argument depends on a concept that he frequently invokes across his whole literary production, *symmetria*, which should not be rendered in English as "symmetry" but as something like "commensurateness." *Symmetria* means having the parts of something scaled appropriately to the whole entity, or having the entity scaled appropriately for its setting or application; in particular, the things that we make ought to have the right size and proportions for human use. It has often been remarked, for example, that Ptolemy never specifies the actual dimensions of the various instruments for astronomical observations that he tells us how to make in the *Almagest*, but he regularly says that they should be *symmetra*, "of appropriate size." When drawing a map, therefore, we should keep in mind that the purpose of the map is for people to look at it, and so we should consider the task in terms of optics. The map as a whole should be of such a size that it neither greatly exceeds the field of view of a spectator at whatever distance the situation calls for nor occupies too tiny a part of the field of view. And again, the level of detail on the map should be commensurate with the resolution of the spectator's sight.

At issue is not merely the number of features per square inch marked on the map, but the character of their portrayal: in *chōrographia*, the imitation of a small region, it is reasonable to aim for a kind of pictorial realism that would be entirely inappropriate in a map of the entire known world. Again one suspects that this is not an account of the way people actually make maps, but of how Ptolemy believes that they should make them. Since he is not really concerned in the *Geography* with how to make pictures of small regions, the target of his remarks would appear to be world maps that incorporate realistic images of physical features, towns and cities, and other monuments. His aim is to impose a clear separation of art from science, such that the world map becomes a strictly scientific object, constructed, as he says, "purely by means of lines and labels."

Indeed, Ptolemy now emphasizes that a world map is a mathematical object, in the strong sense that he has of mathematics as a means of grasping truths about the quantitative and spatial attributes of a body, in this instance the terrestrial globe and its features. In short, the map is mathematical because of the geometrical structure of the cosmos. Having brought up in a preliminary way the mathematical mode in which the map should represent reality, he turns now to the appropriate strategies for acquiring the knowledge to be embodied in the map, namely the absolute and relative locations of terrestrial features on the globe.

The importance of this part of Ptolemy's argument is not that he has new methods of acquiring positional information; the methods that he refers to had been known to Greek

geographers for centuries. His contribution is a criterion for evaluating these methods. One method, or perhaps it would be better to say one class of methods, Ptolemy characterizes as *geōmetrikon*, a term that in this context does not mean "geometrical," but reflects its etymological sense of "pertaining to land measurement." Briefly, this is a deduction of the location of one place relative to another from an empirical datum of the kind, "*B* is so many distance units from *A* in such-and-such a direction." In principle Ptolemy envisions such a datum as having been obtained by first finding the direction of north at *A*, then establishing the direction from *A* to *B* relative to this north, and finally traveling in a perfect straight line from *A* to *B* while measuring the traversed distance. (This is obviously meant as an idealization of the messy processes actually underlying such geographical data.) The second method is *meteōroskopikon*, "pertaining to observation of the heavens," by which he means any procedure for extracting positional information regarding a locality from observations of the heavenly bodies made at that locality.

Ptolemy contrasts the methods according to two standards, by both of which the second, astronomical method is found superior. He tells us that an astronomical determination of a location can be performed without recourse to distance measurements, whereas any determination of the relative position of two places by distance measurement requires an astronomical observation to establish which way is north. But besides this matter of dependence, he tells us that the astronomical method is "more indisputable" (*adistaktoteron*, a favorite word with Ptolemy), while the distance-measurement method is "rougher" (*holoscheresteron*, again a favorite word). He illustrates his point by observing that the journey from *A* to *B* is seldom rectilinear, and (if it is across water) the speed of sail, on which the estimate of distance depends, is seldom uniform. But he has not really evaluated the relative accuracy of the two methods objectively. He is ready to rely, for example, on reports of the local times when a lunar eclipse is observed in two different places to obtain their longitudinal separation, without worrying about the difficulty of obtaining accurate reports of these times. One cannot help concluding that astronomical measurement is superior in Ptolemy's eyes on *a priori* grounds, because knowledge of the heavens is more secure than even mathematical knowledge relating to mundane objects.

If Ptolemy had been engaged in another scientific project (the analysis of pitch systems in the *Harmonics*, say, or the deduction of planetary systems in the *Almagest*), which reached the conclusion that method *X*is in all ways superior to method *Y*, he would then have proceeded to a complete rejection of method *Y*. In cartography this is not possible, however, because, as he has earlier remarked, the earth cannot be inspected part by part by any individual. In consequence Ptolemy is at the mercy of whatever empirical data he can lay hands on, and it is overwhelmingly of the distance-measurement variety. He therefore proposes a "plan B," to establish a scattered network of locations on the basis of the "more indisputable of the reports" (again that word *adistaktoteron*!), relative to which the other places are to be situated as best they may. Significantly, Ptolemy phrases this proposal without explicitly equating "more indisputable" with "astronomical," so that he lays the way open for a relative prioritization even among the available distance-measurement reports.

## Ptolemy and Marinus

We are now at the point of learning where Ptolemy intends to find the specific data for

his map; and the answer is surprising, indeed almost without parallel in Greek scientific literature. It turns out that, in spite of the foregoing review of the possible methods of data gathering, Ptolemy has no intention of conducting a new broad survey of the available reports of distances, directions, and astronomical phenomena. Instead he is prepared to acquiesce in the work of a predecessor, Marinus, but not before subjecting him to a round of criticism that might seem more suitable for a polemic than for an acknowledgment of indebtedness. Polemic, to be sure, is a common enough element in the writings of Greek intellectuals. But Ptolemy is elsewhere a most unaggressive author, brief and sparing in his barbs against contemporaries and predecessors, whom he rarely names. In the *Almagest* he does single out Hipparchus for quite a few errors, but he is careful always to speak of him as an intellectual equal whose very lapses are the symptoms of a burning love of truth.

With Marinus the case is different. Ptolemy starts off with tepid compliments: Marinus has the accidental virtue of being the most recent gatherer of cartographic data, and he was diligent. Then for page after page Ptolemy goes after Marinus's mistakes and misjudgments. He seems to be saying, "See what riches Marinus has accumulated; but see how incompetent he was to organize, sift, and exploit them!" Ruthlessly, Ptolemy dispossesses Marinus of the authority over his own data, so that by the end he has established himself as its new and better master.

The first part of the attack goes after Marinus's grasp of astronomy, with perhaps an oblique retrospective justification of an earlier misstep of Ptolemy's own. In the *Almagest* Ptolemy had written that the regions at the earth's equator might well be habitable, but that anything people said about them was guesswork because up to now no one from his part of the world had traveled so far south. Marinus, however, maintained correctly that the "known world," that is, the regions reached by people from the Greco-Roman world, extended well south of the equator, and part of his argument consisted of observed astronomical phenomena. Ptolemy's review of these is devastating: Marinus turns out not to have known the difference between a predicted phenomenon and an observed phenomenon, and even when he is talking about real observations, he fails to see that they are all compatible with places of observation north of the equator. Marinus is left stripped of credibility with respect to handling the highest order of cartographical data.

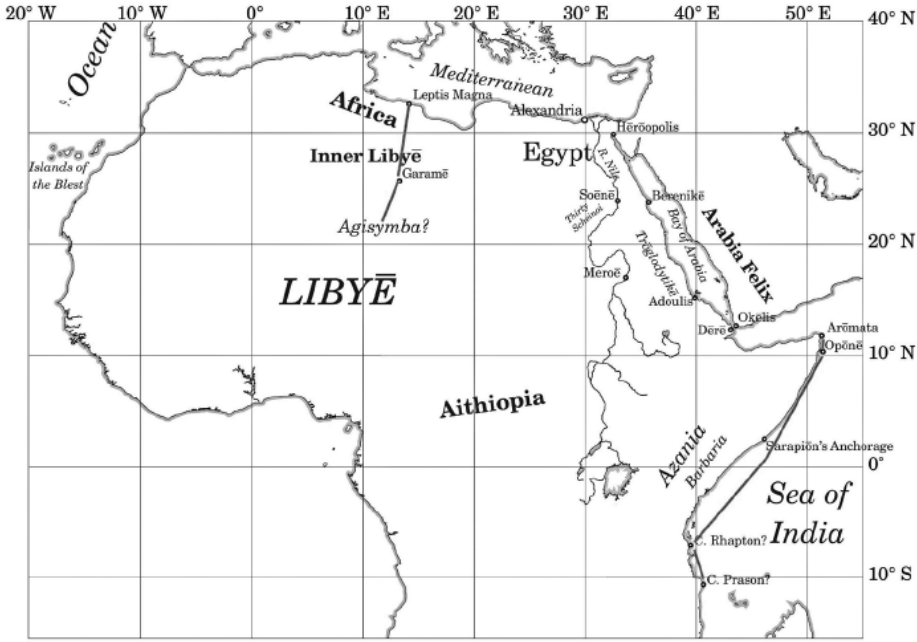



FIGURE 4.3 Conjectural routes of the journeys providing the basis for Marinus's estimate of the southern extent of the known world. He seems to have ultimately settled on the southern tropic (approximately 24 degrees south) for the latitude reached by both routes, whereas Ptolemy argued for about sixteen degrees south. In fact, while Greco-Roman traders regularly reached points well south of the equator along the east coast of Africa in Ptolemy's day, the Romans who were said to have traveled overland to an otherwise unknown place called Agisymba probably did not get far beyond the *northern* tropic. Drawing by the author.

Nor does Marinus fare much better at Ptolemy's hands with respect to his use of data of the distance-measurement variety. Continuing his review of Marinus's argument seeking to establish how far south the known world extends, Ptolemy explains how Marinus estimated this distance from a handful of reports of the duration of southward journeys by land across the Sahara and by sea along the east coast of Africa (fig. 4.3). Marinus turns out to have converted these durations into distances naively, just multiplying the reported numbers of days by rule-of-thumb estimates for an optimum rate of travel; hence he obtained the absurd result that the travelers concerned had apparently reached a latitude as far south of the equator as the southern Ukraine and the English Midlands lie north of it. Ptolemy's criticism is not that this result is unacceptable (Marinus himself admitted as much), but that Marinus had no rationale for his subsequent decision to reject his calculated distance and simply situate the southern limit at the Tropic of Capricorn.

Ptolemy has no difficulty in demonstrating that a careful reading of the travelers' reports will turn up reasons for doubting the wisdom of treating their routes as steady and rapid southward journeys. Are the reports worthless, then? No, he believes, because they include a kind of information that Marinus did not exploit, namely what the travelers found at their destination: people with very dark skin color, and elephants, and gatherings of rhinoceros. We can estimate, therefore, that they had reached a latitude no further south of the equator than we find such people and animals north of the equator.

In reasoning thus, Ptolemy shows that his prioritization of the levels of attainable knowledge permits some flexibility. Marinus's method fell within the category of the mathematics of mundane objects, whereas Ptolemy's belongs to the category of physics, since it presumes some degree of regularity in the qualitative, physical effects arising from one's situation relative to the sky and the sun. He stresses that inferences drawn from such environmental considerations are inexact and unreliable, but they are preferable to a *bad* inference from mathematical considerations. However, the moment someone comes back from these places with a measurement of a gnomon's shadow length on an equinox or some other astronomical observation yielding latitude, we can forget about the rhinoceros.

The outcome of a long examination of Marinus's efforts to estimate how far the known world extends eastwards is a similar impression that he relied upon inappropriately naive assumptions that travelers by land and sea made long journeys in a straight line eastwards at a rapid, steady pace (fig. 4.4). In this instance, however, Ptolemy cannot offer an alternative physical criterion to replace the distances and times in Marinus's reports, so instead he still works from his data, but subjects the numbers to systematic corrections that are supposed to compensate for the presumed indirectness and variable speed of the journeys. In this section Ptolemy also invokes analogy as a means of filling gaps in the quantitative information of the reports, although this is clearly a method of last resort.

Ptolemy's theme now shifts back from wrong and right methods of research to wrong and right methods of representing data. One aspect of this topic is the question, what should the map look like, and how should it be laid out? It is the question with which Ptolemy began his book, and it was only partially answered there to the effect that the map should be a schematic, geometrical drawing having an appropriate size and level of detail. But before resuming this topic, he raises a prior question, how *texts* should present the data obtained by digesting and analyzing the reports and observations that constitute our empirical evidence. Here Ptolemy assumes a stance that was not necessarily shared by his predecessors in the cartographic literature from Eratosthenes to Marinus, namely that a cartographic text ought to provide in and of itself all the information that one needs to draw a world map. So far as we can tell, these earlier authors, including Marinus, did not try to cite in their texts every individual feature and locality that was to be marked on a map; still less did they mean to provide an exact location for every place. Rather, the texts dealt with certain geographical issues, the resolution of which would establish a partial framework for marking places on the map; but within that framework many places might be incorporated in the map directly from the source material. Thus Marinus wrote sections, or possibly entire books, on special topics such as determining localities that lie along certain lines of latitude. If this was how he worked, then it might not seem quite fair for Ptolemy to fault him for failing to provide a comprehensive body of data that he had never even intended to provide.

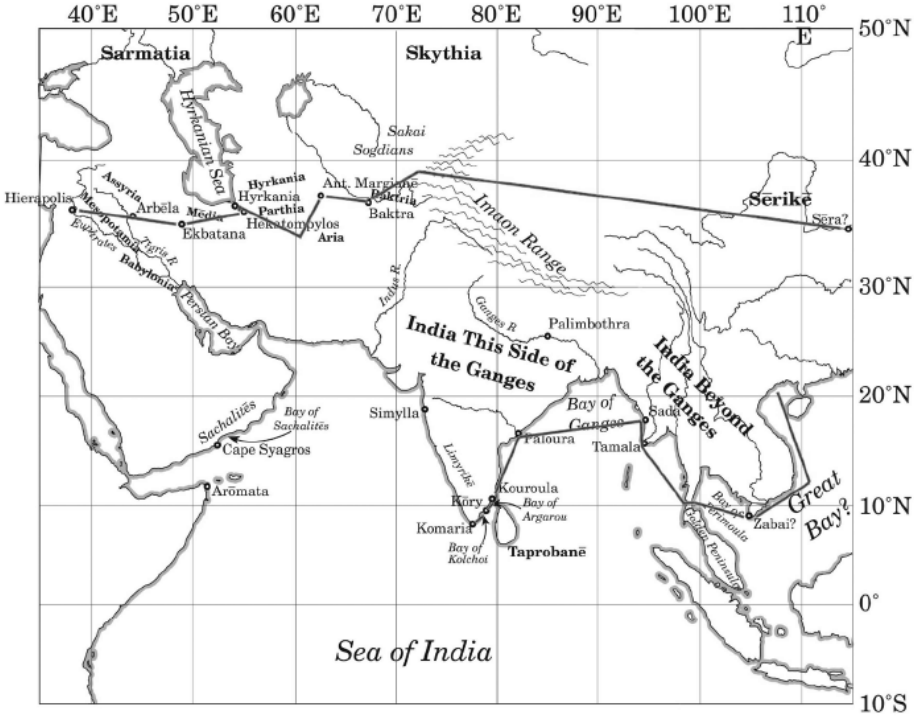



FIGURE 4.4 Marinus's and Ptolemy's discussions of the eastward extent of the known world were based on reports of trade routes across central Asia (the "Silk Road") and the Indian Ocean coasts. Ptolemy reduced Marinus's greatly exaggerated estimate of the longitudinal interval covered by these routes, but not by nearly enough. Drawing by the author.

However, Ptolemy softens up Marinus's defenses by means of a rapid-fire barrage of mistakes and inconsistencies that he has detected here and there in his writings. The point is clear: even on his own terms, Marinus cannot avoid getting into tangles of conflicting information, because his text is not structured in the best possible way.

Ptolemy's idea of the best possible presentation of the data for the map is radically different from any earlier geographical text. The idea for it almost certainly came out of his astronomical work. In his *Almagest* (bks. 7 and 8), he produced a catalog of about a thousand stars, grouped by constellation and with numbers to indicate their brightness and their position in the sky. The position numbers are angles measured in degrees, the first number showing what point of the zodiac circle is directly north or south of the star, and the second number showing how far north or south the star is from the zodiac circle. In other words, this is a system of coordinates. Ptolemy's name for the position along the zodiac circle is *mēkos*, which means "length," but by way of Latin we get the technical term "longitude." His name for the position north or south of the zodiac circle is *platos*, "breadth," or "latitude." These are of course the same terms that were used in geography to designate a locality's position along the equator and north or south of it.

One reason for having this catalog of stars is to help with analyzing astronomical observations, for example sightings of planets near bright stars which might be used to establish theories of planetary motion. But Ptolemy also has in mind that one might wish to construct a globe representing the stars and their constellations. Since he intends the globe to be as exact an image as possible of the visible heavens, there is no question of

simply daubing pictures of the constellations freehand on its surface. One sets up graduated rings, a fixed one along the zodiac circle and a swinging one at right angles to the first ring, and one uses these to mark each star at the position indicated by the numbers of degrees in the catalog.

It was obvious how this approach could be transferred to the context of terrestrial cartography. Instead of stars, one is now plotting localities: cities, promontories and bays, points along rivers, and mountains. Of course a map does not consist only of isolated points, but for extensive features such as coastlines, rivers, and mountain ranges one can record numbers representing the positions of a few points distributed along the feature's length, and the mapmaker will understand that it is necessary to join them up with a continuous line. But now at last we see why it was so important for Ptolemy to assert at the outset that the map is a geometrical artifact, not an object of art.

Ptolemy's catalog of localities in the *Geography* is an enormous document, accounting for about three-quarters of the bulk of the treatise, with about eight thousand places. Each place is assigned its two numbers of degrees, a longitude measured eastwards from the western edge of the map, and a latitude measured north or south of the equator. Each number is expressed to a precision of a twelfth of a degree, which would be equivalent to about 8 km or less. Readers who skip straight to the catalog without reading Ptolemy's introduction might suppose that he is claiming great accuracy for all these positions, as if they were all measured carefully with first-rate astronomical instruments.

But that is not the reason for Ptolemy's precision. What he does not say outright, although it becomes obvious as soon as one tries to imagine how he must have proceeded, is that he had to draw a map first, and only then did he compile the catalog by reading off each position from the map. His original map would have been based on the information scattered throughout Marinus's writings, possibly on actual maps drawn by Marinus or other geographers, as well as on a certain amount of new geographical information that he had managed to obtain himself, mostly concerning south Asia and east Africa. The twelfth-of-a-degree precision of the catalog was necessary not because Ptolemy believed that the map was really this accurate, but because he wanted the numbers to represent with sufficient faithfulness all the little wiggles in the coasts and rivers and the relative positions of cities in the denser regions.

Ptolemy's invention of the geographical catalog obviously represents a huge advance in the reproducibility of maps. But there was also a huge cost. He has effectively renounced the obligation to provide verbal justifications for the map's details. The arguments in his introduction are there only to make his general methodological points, to distance himself from Marinus, and to establish the extreme limits of the map. The user of the *Geography* has to accept everything inside these limits on faith, or look back to Marinus's books in search of the underlying evidence and reasoning. To the extent that Ptolemy's *Geography* served as a model for later cartographic works, it tended to suppress the dialectical, argumentative aspect that had been so prominent in the earlier Greek tradition. The book became nothing more nor less than an encoding of the map.

Both Marinus and Ptolemy assumed that the actual layout of the map had to be established through a grid of lines representing meridians of longitude and parallels of latitude, in the first instance because all geographical locations, however they were originally deduced, must ultimately be referred to the spherical earth with its equator and poles. One possibility was that the map could be drawn, like Ptolemy's star map, on

the surface of a large globe; but of course it was more often expected that a map should be drawn on a large flat surface. The fact that Marinus used a simple rectangular grid of meridians and parallels (in modern terminology, a “cylindrical projection”) suggests that he saw the framework primarily as an organizing device giving structure to the map. Ptolemy has other concerns foremost in mind. His first desideratum is that distances as represented on the map should be approximately proportionate to distances on the actual earth, regardless of where they lie or in what orientation. The second, and actually more important, concern is that the map as a whole should impart to the spectator the truth about our place in the cosmos by *looking* like part of a globe. Hence he offers us two choices for a grid for the map, in which some or all of the parallels and meridians are represented by circular arcs to impart the curved appearance that they would have for a spectator looking at a globe, and in which the spacing of the meridians is broadest at the equator and narrows towards either pole (figs. 4.5 and 4.6). The second grid, in particular, would be quite challenging to draw, especially on a large scale, but it undoubtedly achieves Ptolemy’s aim of looking like a spherical surface by means of a kind of qualitative perspective (figs. 4.7 and 4.8 and plate 4).

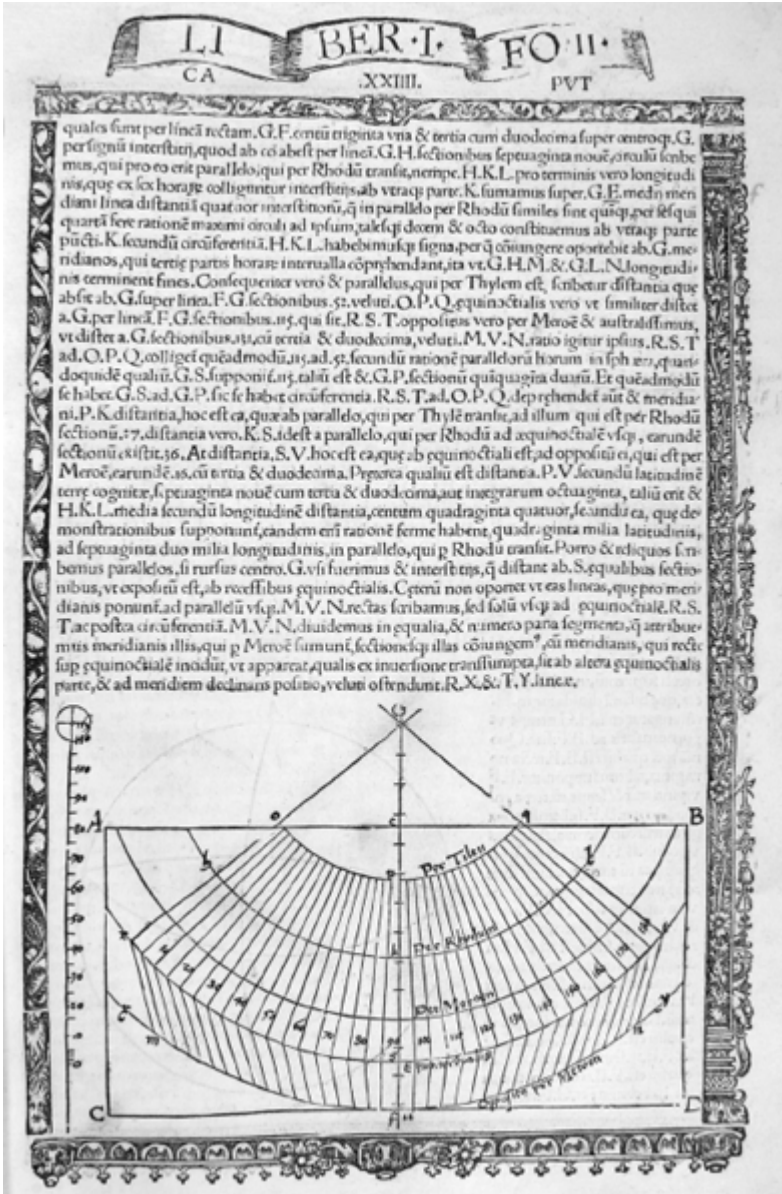



FIGURE 4.5 Grid for Ptolemy's first method of drawing a planar map of the known world, from Claudius Ptolemy, *Geographia*, translated by Willibald Pirckheimer, with annotations by Regiomontanus, edited by Johann Huttich, maps by Laurent Fries (Strasbourg: Johannes Grüninger, 1525). The Newberry Library, Gift of Edward E. Ayer. Reproduced with permission.

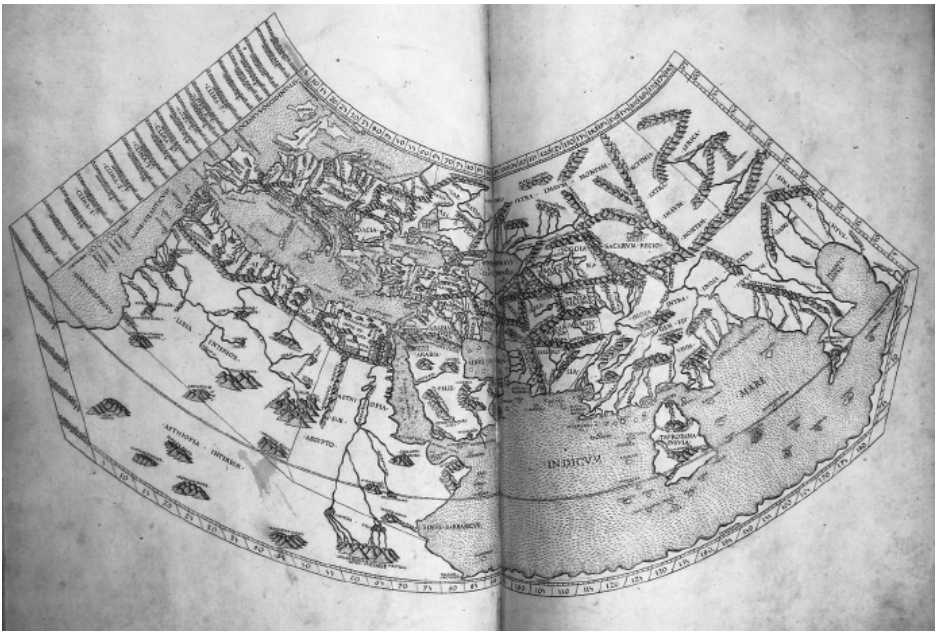
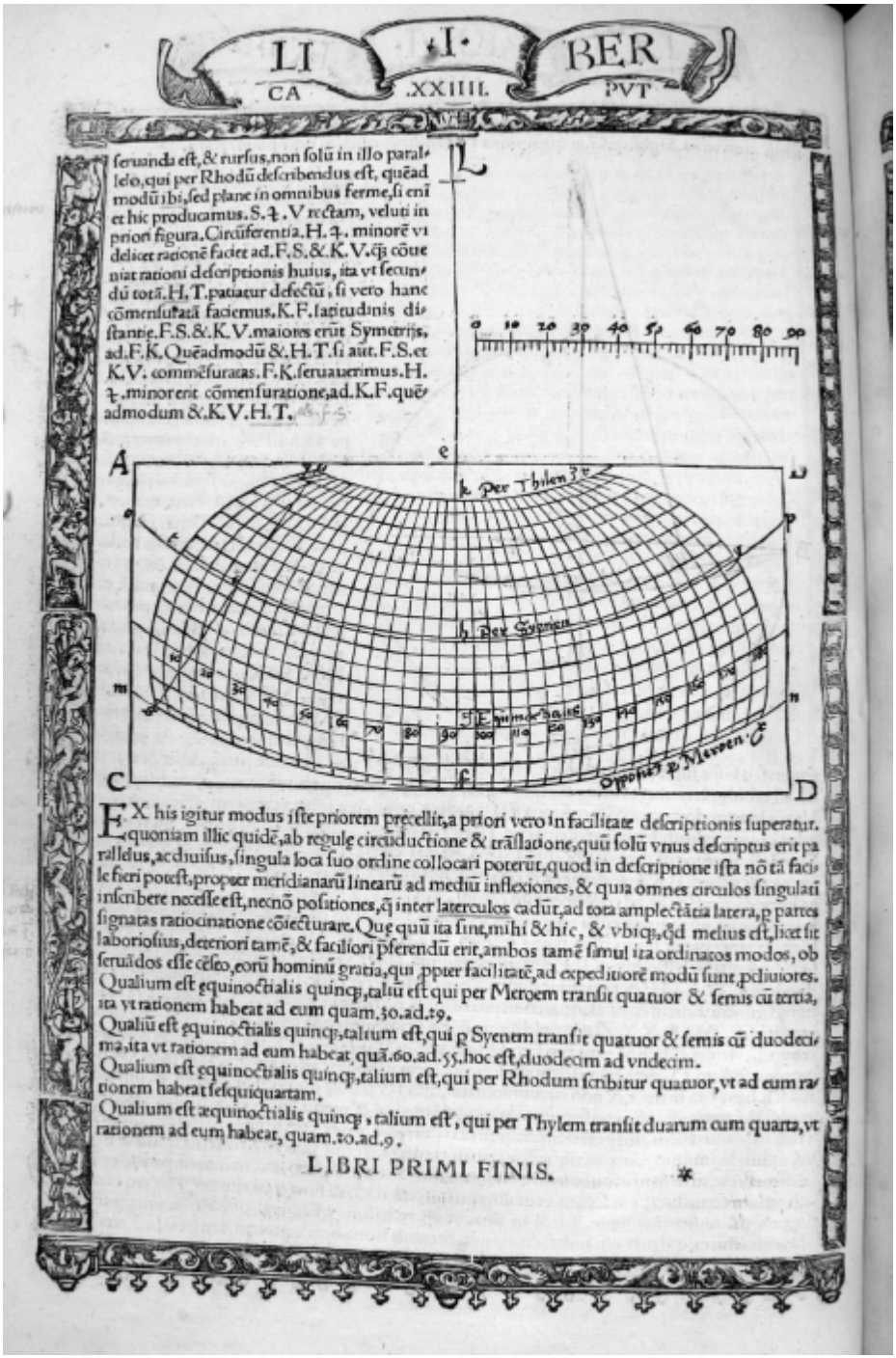



FIGURE 4.6 The world map drawn according to Ptolemy's first method, from Claudius Ptolemy, *Geographia*, edited by Domitius Calderinus, map engraver unknown (Rome: Arnold Buckinck, 1478). The Newberry Library, Gift of Edward E. Ayer. Reproduced with permission.

In spite of all his differences with Marinus, Ptolemy depends heavily on him for the content of the map. We have this by Ptolemy's own admission, and it is consistent with the fact that the geographical information in his catalog best fits a date close to the beginning of the second century, except for those regions around the Indian Ocean about which he tells us he had more recent sources. We should not undervalue Marinus's achievement. His knowledge of the localities of the world was both more detailed and more extensive by far than that of any other Greco-Roman author known to us. Even through the filter of Ptolemy we can tell that he drew upon a huge range of source material, the value of a large part of which would have eluded the comprehension of such an author as Strabo. Ptolemy complains about the inconvenient plan of Marinus's writings, but the fact remains that he succeeded in constructing on their basis a map that creditably represents the physical outlines of most of the world that it covers, including such remote regions as Southeast Asia. Indeed, it still remains usable as a tool for the study of ancient history.

In one important respect Marinus and Ptolemy apparently saw eye to eye. Both disagreed with certain tendencies of cartography in the Roman imperial period, as the austere, unpolitical character of Ptolemy's map demonstrates. Consider what features his catalog records. First, there are physical features: points defining coasts, rivers, and mountains. Second, there are cities, a few of which are designated as "metropolis," although this term does not appear to have a systematic signification. Third, there are the names of native peoples or nations, which are not assigned coordinates in their own right but are roughly situated according to the cities within their districts. Last, there are the boundaries separating what Ptolemy loosely calls "provinces and satrapies": these include provinces of the Roman empire, administrative divisions of the Parthian empire (antiquated by Marinus's time), and an assortment of more far-flung regions. Strikingly,

Ptolemy gives not the slightest indication that there exists such an entity as a Roman empire, nor does he tell us which of the “provinces and satrapies” are units of government and which are merely designations of geographical convenience. Notwithstanding the fact that texts detailing road systems must have been among the sources underlying the map, no road is shown. The center of the map is not Rome or Alexandria, but the Persian Gulf.[13]



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seruanda est, & rursus, non solũ in illo parallelo, qui per Rhodũ describendus est, quẽadmodũ ibi, sed plane in omnibus ferme, si enĩ et hic producamus. S. ♃. V rectam, veluti in priori figura. Circũferentia. H. ♃. minorẽ vi delicet rationẽ faciet ad. F. S. & K. V. q̃ cõueniat rationi descriptionis huius, ita vt secundũ totã. H. T. patiatur defectũ, si vero hanc cõmensuratã faciemus. K. F. latitudinis distantię. F. S. & K. V. maiores erũt Symetrijs, ad. F. K. Quẽadmodũ & H. T. si aũt. F. S. et K. V. commẽsuratas. F. K. seruauerimus. H. ♃. minor erit cõmensuratione, ad. K. F. quẽadmodum & K. V. H. T.

EX his igitur modus iste priorem precellit, a priori vero in facilitate descriptionis superatur. quoniam illic quidẽ, ab regulę circũductione & trãslatione, quũ solũ vnus descriptus erit parallelus, ac diuisus, singula loca suo ordine collocari poterũt, quod in descriptione ista nõ tã facile fieri potest, propter meridianarũ linearũ ad mediũ inflexiones, & quia omnes circulos singulatĩ inscribere necesse est, necnõ positiones, q̃ inter laterculos cadũt, ad tota amplectãtia latera, ꝑ partes signatas ratiocinatione cõiecturare. Quę quũ ita sint, mihi & hic, & vbiq;, q̃d melius est, licet sit laboriosius, deteriori tamẽ, & faciliori ꝑferendũ erit, ambos tamẽ simul ita ordinatos modos, obseruãdos esse cẽseo, eorũ hominũ gratia, qui ꝓpter facilitatẽ, ad expeditiorẽ modũ sunt ꝓcliuiores.

Qualium est ęquinoctialis quinq;, taliũ est qui per Meroem transit quatuor & semis cũ tertia, ita vt rationem habeat ad eum quam. 30. ad. 29.

Qualiũ est ęquinoctialis quinq;, talium est, qui ꝑ Syenem transit quatuor & semis cũ duodecima, ita vt rationem ad eum habeat, quã. 60. ad. 55. hoc est, duodecim ad vndecim.

Qualium est ęquinoctialis quinq;, talium est, qui per Rhodum scribitur quatuor, vt ad eum rationem habeat sesquiquartam.

Qualium est æquinoctialis quinq;, talium est, qui per Thylem transit duarum cum quarta, vt rationem ad eum habeat, quam. 20. ad. 9.

LIBRI PRIMI FINIS.

FIGURE 4.7 Grid for Ptolemy's second method of drawing a planar map of the known world, from Claudius Ptolemy, *Geographia*, translated by Willibald Pirckheimer, with annotations by Regiomontanus, edited by Johann Huttich, maps by Laurent Fries (Strasbourg: Johannes Grüninger, 1525). The Newberry Library, Gift of Edward E. Ayer. Reproduced with permission.

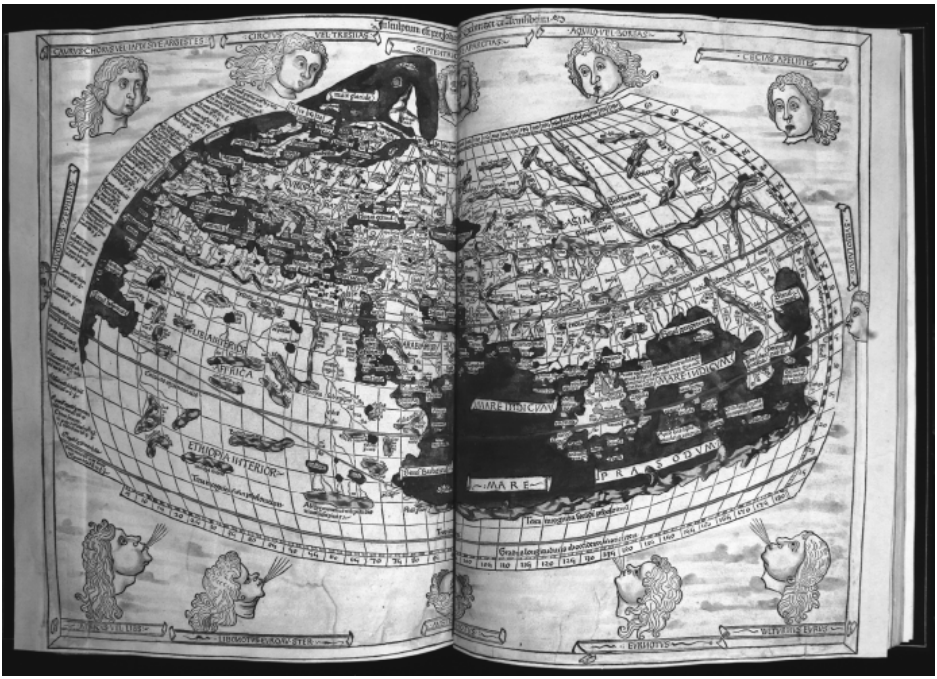



FIGURE 4.8 The world map (incorporating some revisions in northwestern Europe), drawn according to Ptolemy's second method, from Claudius Ptolemy, *Cosmographia*, based on a manuscript edited and with maps by Donnus (Dominus) Nicolaus Germanus (Ulm: Johann Reger, 1486). The Newberry Library, Gift of Edward E. Ayer. Reproduced with permission.

If there is a rationale behind the choice of what the map does and does not display, it seems to be that peoples and cities are objective realities, effectively part of the physical landscape, whereas other human institutions do not merit a place in what professes to be a picture of the known world. Ptolemy's map is not about power or prestige, but about our place in a cosmos that on the whole has much more important matters to concern itself with than mere human beings.

# FIVE

## Greek and Roman Surveying and Surveying Instruments

Michael Lewis

### Background and Principles

There are two branches to surveying. One involves measuring any part of the earth's surface and any artificial features on it and plotting the result on a map or plan drawn to a suitable scale. Often, though by no means always, this work also involves recording relative heights. The other branch, which we call "laying out" or "setting out," is the reverse process, namely, positioning intended features such as boundaries or buildings or engineering works on the ground, in the correct position in all three dimensions. The surveyor often has to carry out both procedures, especially when linear features such as aqueducts or railways are to be built. First he has to record the existing shape of the terrain and then, in the light of this information, to decide the best route and to mark it on the ground.

In the Western world, although the contributions of Mesopotamia and Persia should not be overlooked,[1] the development of surveying was especially important in Egypt, where simple procedures were devised for dividing land, calculating the areas of fields, and restoring their boundaries after the Nile floods. Here grew the roots of geometry, not only in its usual secondary sense but also in its literal meaning—the measurement of land—and at the heart of this geometry lay triangles and especially similar triangles. The height of an obelisk, for example, could be learned by planting near it a vertical post and at the same time measuring the length of both shadows and the height of the post. The ratio of height to shadow length is the same for the obelisk as for the post.[2] The principle of leveling, too, was evolved. A horizontal could be established from a water surface—a crude predecessor of the spirit level—or, much more commonly, by deriving it from the vertical supplied by a plumb line. Here the basic Egyptian tool was the A-frame level, in the form of a large wooden A from whose apex a plumb line hung (Coulton 1982, 46). When this line coincided with a mark on the center of the crossbar, both feet of the A were at the same height. Such tools and methods, though modest, were no doubt adequate for most purposes.

Yet Egypt could rise on occasion to remarkable feats of precision. The four sides of the Great Pyramid, for instance, diverge from true north-south and east-west by a maximum of 5½ minutes of arc and a minimum of 2 minutes. In this case, north was probably found by building an artificial horizon in the form of a temporary circular wall, its top made exactly level by water in a trough. From a vertical post at the center a surveyor would mark the precise points on the top of the wall where a star rose and set; bisecting the resulting angle gave him true north.[3]

In the sixth century BCE the elements of geometry and of surveying were acquired from Egypt by Greek philosophers, just as they acquired mathematics from Mesopotamia and, arguably, tunnel building from Persia. But the development of more sophisticated

surveying theory and of more versatile and accurate instruments had to await the creation in the early third century BCE of the famous library and museum at Alexandria —Egypt by now being a Greek kingdom—and the beginnings of more truly scientific enquiry. Surveying instruments now entered the realm of high technology for the first time; that is, they drew on scientific theory and, from practical experiment, fed back to it.

We know a good deal about Greek surveying from four technical treatises. Only one is virtually complete: Hero of Alexandria's *Dioptra*, of the first century CE but incorporating earlier material. The others comprise fragments of anonymous manuals of probably the third and second centuries BCE which are embedded in works by later writers: Julius Africanus, the so-called Anonymus Byzantinus, and (in Arabic translation only) al-Karaji.[4] Their content of practical exercises accompanied by geometric diagrams bears a close family resemblance to surveying manuals of the nineteenth and even twentieth century. For the Romans, in contrast, apart from the voluminous *Corpus Agrimensorum*, which is devoted solely to dividing, measuring, and recording landholdings,[5] the written record is sadly skimpy. Even Vitruvius, the much-admired architectural writer of the early first century CE, is not well informed about surveying. But Roman engineering works in plenty survive to show that instruments and procedures became ever more precise.

These tools were nothing like as precise, of course, as their modern counterparts. Our satellite positioning and lasers would be far beyond the comprehension of the ancient world. Its achievements are better compared with those of the nineteenth-century railway engineers, who worked with theodolite and level. Both of these instruments incorporate optics and the spirit level, which were introduced only in the seventeenth century, and ancient instruments were necessarily less compact and less accurate. The theodolite, too, measures angles; but because in Greek and Roman times trigonometry, which handles angles, was in its earliest infancy, ancient surveyors worked with Euclidian geometry. Even so, the early modern surveyor's approach to leveling was broadly similar, so if an ancient surveyor had joined the party surveying a railway in the nineteenth century, he would not have been wholly out of his depth.

Ancient surveyors, however, are elusive individuals. They seem to have fallen into four main categories. The cartographic surveyor (*chorographos* or *geographos* in Greek; no known equivalent Latin term) made maps of large areas, sometimes establishing latitudes and, indirectly, longitudes by a combination of astronomical and terrestrial methods; he also took an interest in the size of the earth and the heights of mountains. The land surveyor (Greek *geometres* or *geodaistes*; Latin *agrimensor* or *gromaticus*) worked on a smaller scale, plotting fields and laying out rectangular grids for land division or for urban streets. The military surveyor (Latin *mensor*; no known equivalent Greek term) supplied practical information to a commander and his engineers and laid out forts and the like. The engineering surveyor (Latin *mensor* or *librator*; no known equivalent Greek term) investigated terrain with a view to imposing on it roads, aqueducts, irrigation channels, or navigable canals.

The *geographoi*, it seems, were for the most part academics such as Eratosthenes or Ptolemy, who rarely ventured into the field. Of Roman land surveyors, we know the names of some. As for the rest, they are almost entirely anonymous. True, a number of their tombstones survive, but very rarely can we ascribe a particular engineering work to a named individual. Many *mensores* and *libratores* were seemingly jacks-of-all-trades, able to turn their hand to almost any need; in modern parlance, they were as much civil

engineers as narrowly specialist surveyors. Certainly, military surveyors were often seconded to carry out civilian work. The profession in general seems to have been a respected one, and (to judge from the quality of its members' tombstones) reasonably well paid; in the late Roman empire, entry to it was encouraged by the granting of special privileges.

## Instruments and Their Uses, with Special Reference to Greek Practice

So what did these men survey? Maps of large areas were compiled essentially by observation of the altitude of the sun and stars. Ptolemy's *Geography* goes hand in hand with the *Almagest*, his great work on astronomy, as the previous chapter has shown. A classic example of simple celestial observation—Eratosthenes's attempt to discover the circumference of the earth—was explained in chapter 3. Although we know deplorably little about the methods employed, maps of smaller areas must have been surveyed with equipment designed for terrestrial use. Such maps include cadasters of land boundaries, of which that at Arausio (modern Orange) in southern France is the best surviving example; the great marble map of Rome, the so-called *Forma Urbis*; and the long-lost maps which we know existed of Rome's aqueducts.[6] This said, however, it does seem that surveying instruments were used less for recording existing features than for creating new ones—setting out rectangular grids for city streets and land division, establishing routes for roads, meticulously fitting aqueducts into the landscape in order to obtain reasonable gradients, and, hardest of all, driving tunnels so that the ends met. On this sort of surveying we are much better informed.

On the nature of ancient surveying instruments, conventional wisdom is partially astray.[7] It assumes, blindly following Vitruvius, that the standard device for leveling was the *chorobates*. This resembled a narrow trestle table, set up horizontally by plumb lines against marks on the legs and also, for good measure, by a short trough on its top filled to the brim with water.[8] But at 6 m long it was far too cumbrous for use in the field, and it was far too crude. No instrument can be perfect, and its potential inaccuracy must always be borne in mind. When leveling for an aqueduct, for example, the resulting gradient should never be less than twice the error to which the instrument is liable, and even that can leave the surveyor hostage to fortune (see further below). To set out gradients of anything like 1 in 20,000, or 0.005%—which were not unknown, as we shall find, on Roman aqueducts—the top of the chorobates has to slope at no more than 1 in 40,000, or 0.0025%. To achieve even that approximation to the horizontal, and assuming a quite impossible perfection of manufacture, the center of the plumb line has to be aligned to within 0.0375 mm of the center of the mark. The impracticability of such precision is so obvious that no more need be said. Vitruvius had misunderstood his Greek source: the chorobates was in truth a builder's level, not a surveyor's.

Another widespread assumption is that Hero of Alexandria's *dioptra*, a complex and surely expensive instrument, was widely used for leveling (fig. 5.1).[9] In fact, it seems to have been no more than a one-off, a bright idea but a misguided one. It established the horizontal with a water level, in this case a water-filled glass tube bent up at each end. Sights were taken across the two water surfaces, where accuracy would be compromised by the inevitable meniscus. The Greeks did indeed use the dioptra—in fact, it was the only significant instrument they possessed—but they used it in a much simpler and probably more accurate version.

The word *dioptra* simply means something to look through. For surveying, the original

form may have been nothing more than a narrow sighting tube suspended horizontally by wires or chains. Possibly it was first devised in Persia for maintaining alignment and gradient when driving *qanats*, water-collecting tunnels, and was possibly adopted by Greeks in the sixth century BCE. By the mid-third century BCE the tube was pivoted centrally on a circular disk. It is possible, even likely, that this development into a much more flexible instrument was stimulated by the reclamation by Ptolemy II and Ptolemy III of the Fayum depression in Egypt,[10] which involved a complex network of new irrigation canals and the allocation to farmers of a huge area of new land that had to be divided into fields. Probably by the late third century BCE the tube had evolved into the alidade, a bar that carried, at each end, projecting pinnules or vanes which served as sights. At first these vanes each had a small central hole, but, because it was difficult to align the further hole on the target, narrow slits were added, which made sighting very much easier; such slits have remained the norm on comparable instruments to this day. This was the form of the standard dioptra. The main uncertainties about it are the material—was it metal or wood?—and the size.[11]

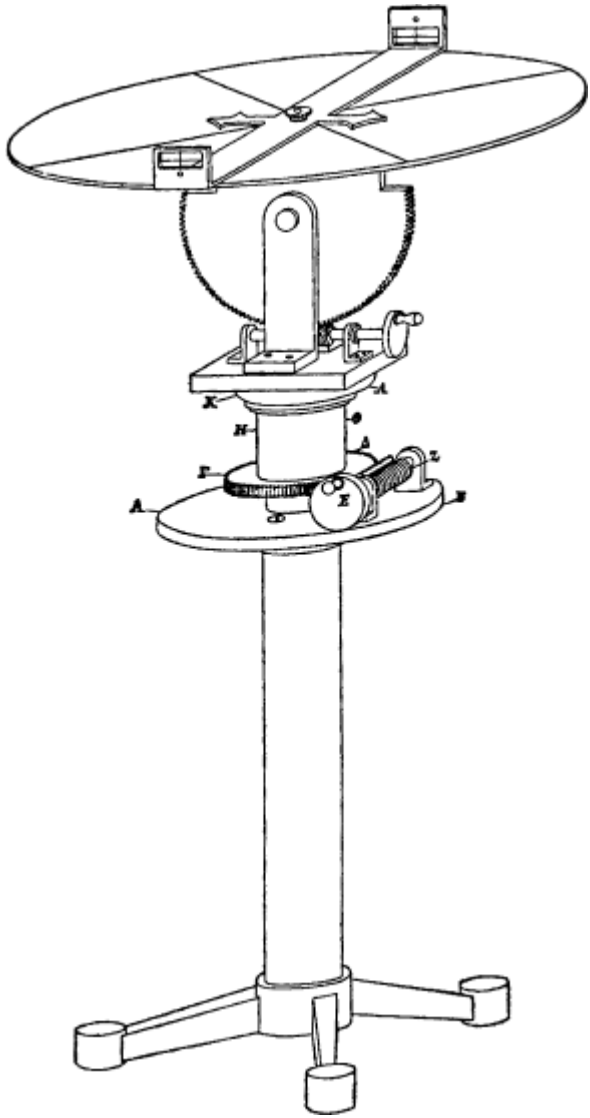


FIGURE 5.1 Hero's dioptra in horizontal mode. Reconstruction reproduced from H. Schöne, "Die Dioptra des Heron," *Jahrbuch des deutschen archäologischen Instituts* 14 (1899): fig. 1.

Because the whole subject cries out for practical experiment, a reconstruction of a standard dioptra was made, the disk being of wood and 60 cm in diameter (fig. 5.2). The sources are full enough to inspire confidence that this reconstruction is quite close to the truth. It works in either of two planes. When mounted horizontally on a tripod by means of a swiveling joint, it is used to project straight lines, in either direction or in both, for marking on the ground, and if necessary to lay out further lines at right angles to them by means of right-angled diameter lines inscribed on the disk. A quarter of the rim is also graduated in degrees, a facility used (as far as we know) for celestial observations but not for terrestrial surveying.

FIGURE 5.2 Reconstructed standard dioptra in horizontal mode. Photograph by the author.

The manuals—especially Hero's—give many examples of the dioptra's use in land surveys, in engineering works, and possibly in mapping. The area of an irregularly shaped field, for example, may be calculated by dividing it into easily measured rectangles and right-angled triangles, leaving only the small residual slivers around the edge to be estimated. A straight line can be established between two points that are not intervisible, which is useful for setting out on the surface the line of a proposed tunnel. The distance between two remote points can be measured without approaching them, which could be applicable to mapping in mountains.[12] It has been suggested that the *Forma Urbis Romae* of the early third century CE, which is remarkably accurate in terms of distances if less so in the orientation of buildings, derives from a survey made by a process of triangulation using dioptras to record horizontal angles in a fashion comparable to that of the modern plane table.[13] This hypothesis may be correct, although the manuals record no such procedures. It does also run counter to two impressions: that Roman surveyors (as opposed to Greeks) barely used the dioptra, if at all, and that its degree graduations were not used for terrestrial work. Both impressions may be wrong: the third century CE is a period much later than that of most of our sources, and changes could have occurred. We simply do not know.

An absolutely typical use for the dioptra, and one that may illustrate its capabilities, was in warfare. An army on the march is confronted by a river, and a pontoon bridge has to be made. How long has it to be? Anyone sent across with a cord to measure the distance directly is liable to be either drowned or slaughtered. On his side of the river, therefore, the surveyor sights with his dioptra a line from A to F, which is some prominent object such as a rock or bush on the far bank, and marks the line with stakes on the ground (fig. 5.3). Moving the dioptra to an arbitrary point C he aligns the

diameter line with F again, and sets out the right-angled line CD, of arbitrary length. From D he sets out another right-angled line DG. Measuring CD, he marks the halfway point E. With the dioptra at E he aligns the alidade with F and, going around to the other side of the instrument, without moving the alidade, projects that line to H, where it intersects DG. Because the triangles CFE and EHD are identical, CF equals DH, which can be measured. Subtract CB, which can also be measured, and BF is the width of the river and the length of the required bridge.[14] A practical experiment with this procedure gave exactly the right answer.

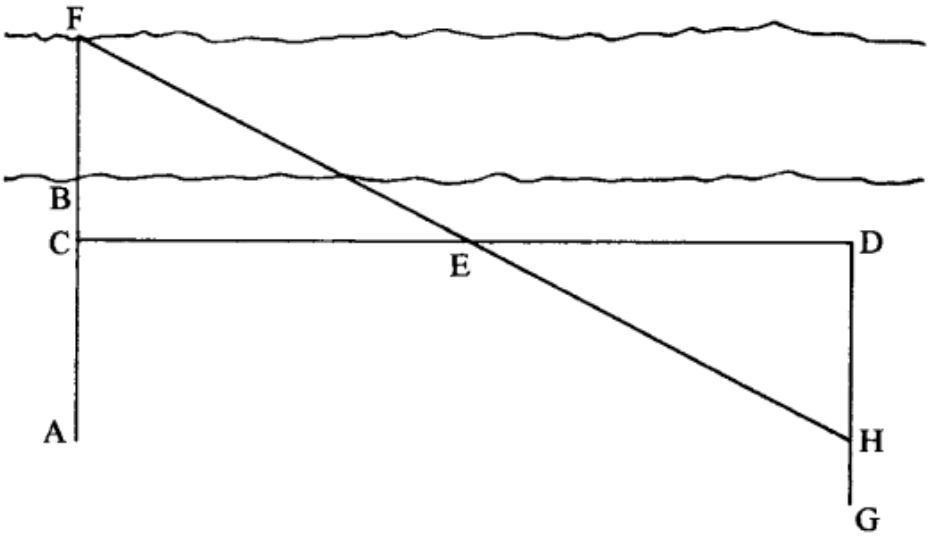



FIGURE 5.3 Measuring the width of a river. Drawing by the author.

In the other mode, for taking heights, the dioptra is suspended vertically from a horizontal peg on a tripod, where it acts as its own plumb bob (fig. 5.4). One diameter line lies vertical, the other horizontal. With the alidade set on the horizontal one, sights are taken on a tall staff held upright by an assistant who, at the surveyor's direction, moves a cursor up or down it to coincide with the horizontal line of sight (fig. 5.5). The staff—Hero specifies a height of 10 cubits, or nearly 5 m—is graduated into cubits and dactyls, or feet and digits, or whatever the relevant units may be (Hero, *Dioptra* [Schöne 1903], 5).

For leveling, the Greeks started with rather inflexible methods but soon settled on one which is identical to modern practice.[15] To find the difference in height between two points A and B, place the dioptra between them, preferably about halfway, although exactitude is not necessary (fig. 5.6). Take a back sight to the staff at A and note the reading. Move the staff forward to B and take a fore sight on it there. The difference in the readings—$x$ minus $y$—is the difference in height between A and B. Repeat the process as far as necessary, which, in leveling for an aqueduct, may well be a matter of miles. The total of the back sights subtracted from the total of the fore sights, or vice versa, gives the total difference in height between the two ends. If gradients are to be derived from the levels, as in the case of an aqueduct, the distances between all the stations of the staff need to be recorded, and their positions need to be marked semipermanently so that the survey line can be picked up again later. With a modern level and telescopic sights, the staff can be read at a considerable distance. With a

dioptra and the naked eye, it cannot. The stages have to be shorter—about 30 m seems to be the reasonable maximum—and therefore more numerous, which increases both the time taken and the opportunity for making mistakes.

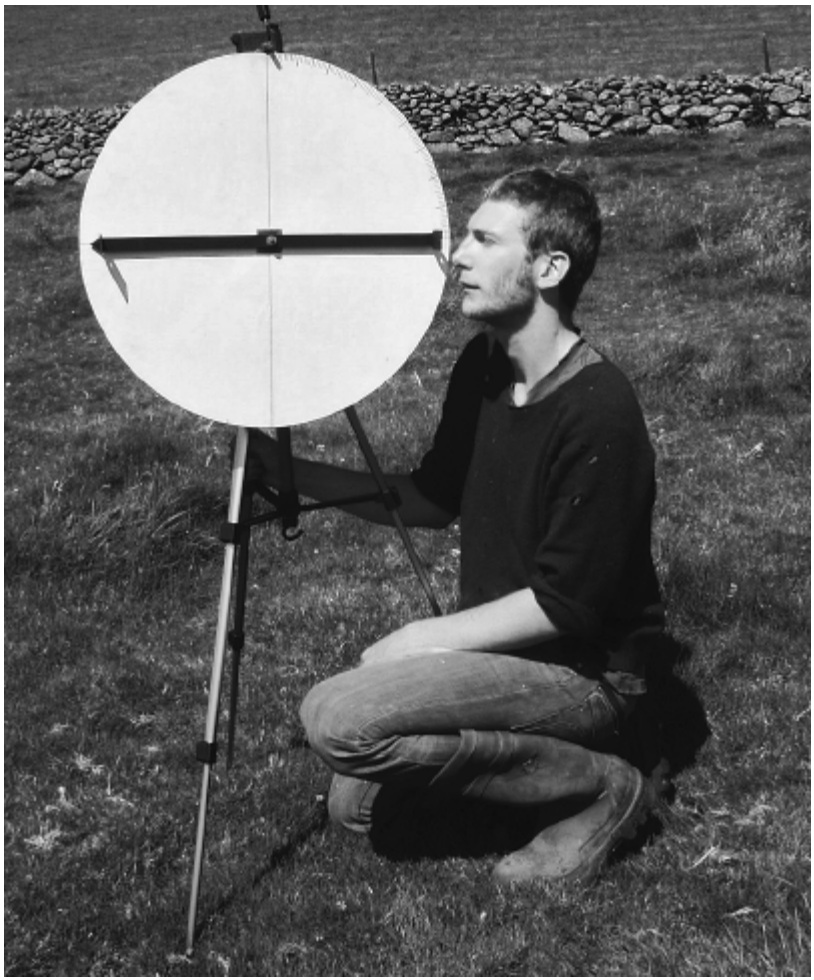


FIGURE 5.4 Reconstructed standard dioptra in vertical mode. Photograph by the author.

Here a cautionary word is needed. Everything depends on the line of sight being precisely horizontal. On a modern instrument with a spirit level it is so, or virtually so. On a dioptra it cannot be, except by luck. Figure 5.7 shows why, in grossly exaggerated form. Suppose the radius of the disk to be 30 cm. If the pointer B of the alidade AB is only 0.1 mm above the true horizontal—an error undetectable by eye—the reading on the staff 30 m away will be 1 cm too high, but the surveyor will not know it. Fortunately there is an easy solution to the problem, not attested by the ancient sources but one which any thoughtful surveyor could have worked out. He simply takes the whole dioptra off the peg from which it hangs and, without touching the alidade, turns it through 180 degrees and puts it back the other way round. He then takes the reading again. Instead of looking through the sights from A to B, he is now looking through them from B to A, and the reading on the staff is now 1 cm too low. The mean of the two readings will be horizontal, or rather a much better approximation to the horizontal.

An experiment on this basis revealed the dioptra's accuracy, or inaccuracy. A distance was chosen, 173 m in length between two immovable stones, and was leveled with a modern level. Repeated checks in both directions established the difference in height as 13.005 m. The exercise was then repeated with the dioptra. Results improved with practice, ending with an average difference of 13.127 m, or 12.2 cm too great. Over 173 m, this represents an error of 1 in 1,418 or 0.07%, which, despite all the precautions taken, is still a very significant one. It was caused no doubt by inexperience on the part of the surveyor, by the relative shortness of the alidade—the longer the distance between the sights, the better—and above all by the fact that, although the disk is suspended from a long sleeve rather than a simple ring, it tends to swing if there is any wind at all.

FIGURE 5.5 Reconstructed standard dioptra leveling. Photograph by the author.

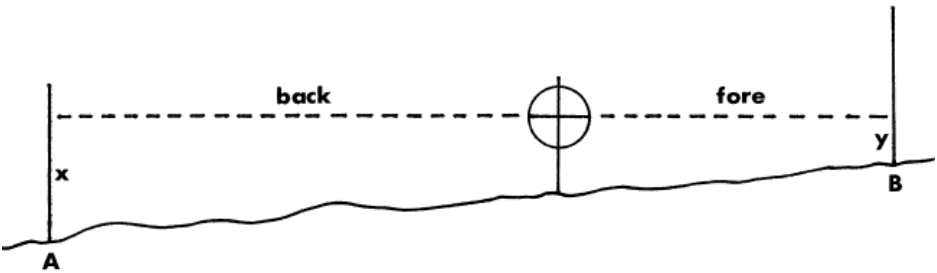



FIGURE 5.6 Principle of leveling. Drawing by the author.

The more accurate the instrument, needless to say, the better. But the degree of accuracy required depends on the task in hand. Let us suppose the surveyor is leveling between two points, 100 m apart, for an aqueduct. The dioptra tells him that one is 10 cm lower than the other: that the gradient is 1 in 1,000 (0.1%) downhill. At least, this is

the theory. Let us further suppose, however, that the readings are, or might be, in error to the tune of 1 in 1,000, either too high or too low. What the surveyor fondly imagines to be a true level might therefore in reality be anything between 1 in 1,000 up and 1 in 1,000 down. Gradients are derived from levels. In subtracting 1 in 1,000 from his supposed level he will end up with an actual gradient which might at one extreme be 2 in 1,000 (i.e., 1 in 500) down, or at the other might be 0 in 1,000 (i.e., genuinely level). This is not good enough: the aqueduct might not work.

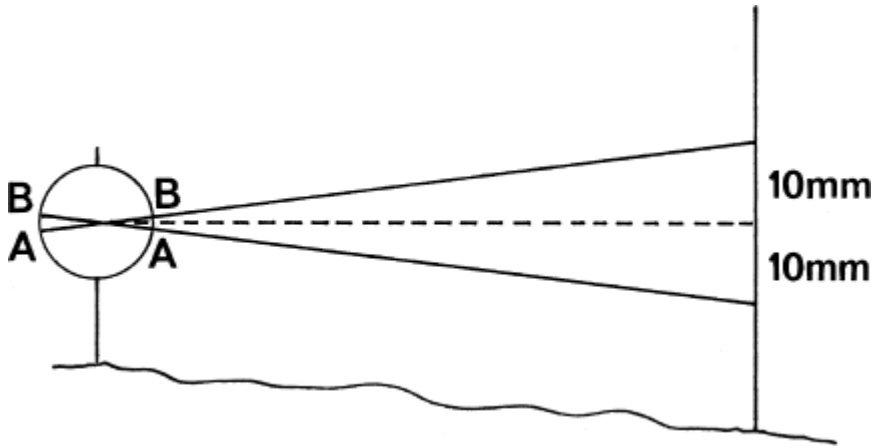



FIGURE 5.7 Averaging out errors by reversing sights. Drawing by the author.

A Greek surveyor, however, would be leveling for Greek aqueducts. These, though not nearly so numerous as those of Roman date, fall into two groups, archaic (sixth century BCE) and Hellenistic (third to first centuries BCE). In both periods they normally run in pipes at a quite steep gradient: the average is roughly 1 in 100 (1.0%), and the minimum, where it is known, rarely shallower than 1 in 250 (0.4%), except perhaps in the distribution network inside a town (Coulton 1987). Roman aqueducts, however—to leap forward briefly in time—typically had very much shallower gradients, as shallow even as 1 in 20,000, or 0.005%. If, as with the reconstruction, a typical Greek surveyor's dioptra had an error of 1 in 1,418, and if he was aiming for a gradient of, let us say, 1 in 200 (0.5%), he might end up with one between 1 in 175 and 1 in 233. This is acceptable: the aqueduct could not fail to work. To survey shallow Roman gradients, however, the dioptra was too crude by far, so that, as we shall see, a very much more accurate instrument was required. The moral is that instrumental error should be, at the very worst, half the gradient intended. Ideally, it should be no more than a tenth.[16]

Nowadays, when the primary leveling is completed, its accuracy is checked by taking "flying levels" back to the starting point. In theory this will bring the cumulative height difference back to zero, although in practice a closing error is tolerated, provided it falls within strictly defined limits. If Greek surveyors had done the same, they too could have found how accurate or inaccurate their survey had been, but there is complete silence in the manuals about any such check. What the Greek world required of its surveyors was probably for the most part nowhere near as stringent as today's demands. But once again a sharp distinction must be drawn between Greek and Roman achievements and therefore, one might deduce, between Greek and Roman requirements. On Roman aqueducts, the smallest error could turn a potential success into an abject failure. For all we know (which for Roman procedures is very little), Roman surveyors may have taken

flying levels to check their results.

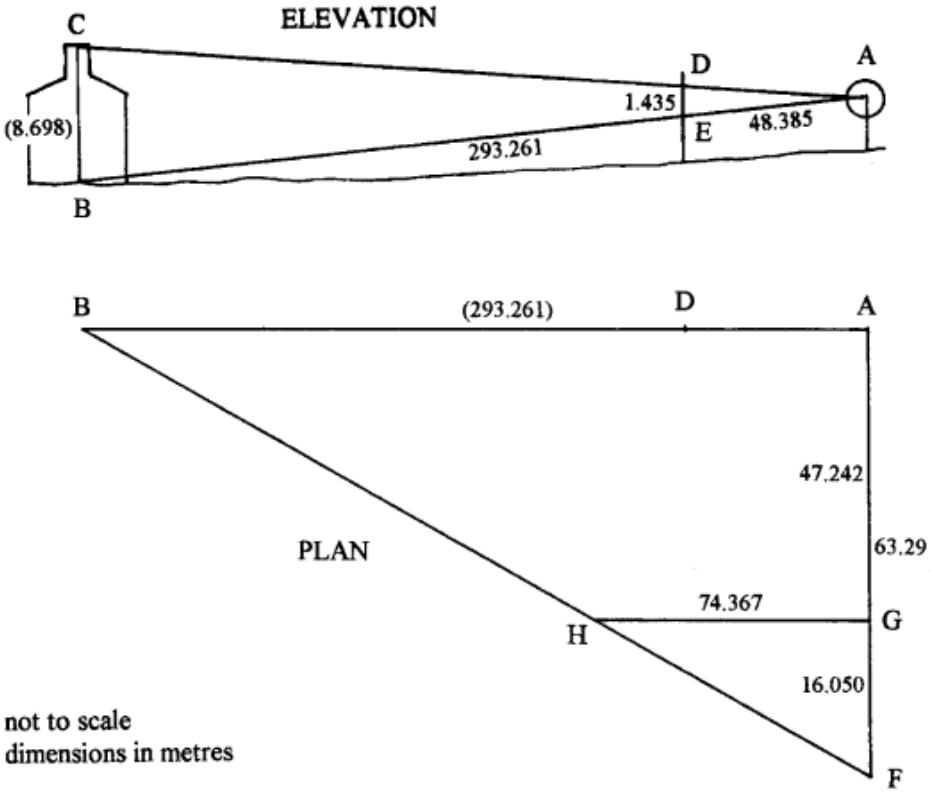



FIGURE 5.8 Measuring the height of a wall. Drawing by the author.

Another use of the dioptra in the military sphere is to measure the height of a wall. A commander is besieging a city and wants to storm it. How high is the city wall? He needs to know in order to build ladders or siege towers of the right size. To try to measure it directly would be suicidal. In default of a suitable city wall, an experiment was made on measuring the height, BC (fig. 5.8), of the chimney stack of a house. This demanded two stages, both taken straight from the ancient manuals.[17] First, with the dioptra in horizontal mode at A, two lines were staked out on the ground: a certain distance toward B and, at right angles, to point F at an arbitrary distance away. With the dioptra at F, another line was staked out in the direction of B. From the arbitrary point G yet another line was staked out at right angles to AF, and the point H where it intersected FB was marked. All this was done safely out of bowshot of the chimney. The result was two similar triangles. The accessible sides were measured, and the ratio of GH to GF, in conjunction with the distance AF, supplied AB, the distance to the chimney. Then the dioptra was set up in vertical mode at A. On a staff held at D, readings were taken on the lines of sight AC (to the chimney top) and AB (to the wall foot). Two more similar triangles resulted. In conjunction with AB, just discovered, the ratio between DE (read from the staff) and AD (measured on the ground) supplied BC, the figure required. When finally the real chimney height was measured directly, it turned out to be 11 cm less than the calculation: wrong by only 0.13%. A siege tower built to the estimate would have been a hand's breadth too tall. Given that the chimney was 293 m away, this was a

respectable result.

In just the same way, but on a much bigger scale, the Greeks worked out the heights of mountains. Their interest arose from their desire to understand the nature of the earth. It was commonly accepted that the earth was a sphere, yet, since mountains very obviously projected above the general surface, it could not be a perfect sphere. By finding the heights of mountains it could be shown that, relative to the diameter of the earth, they were insignificant and did not detract from the basic sphericity. Another question was the depth of the atmosphere: what height did clouds reach? The widespread acceptance that the highest peaks always rose above the clouds gave fuel to this debate.

The earliest attempts to measure mountains were limited by the lack of adequate equipment, and philosophers had to be content with informed guesses, in the roundest of round figures. But as surveying instruments improved, a more accurate assessment became possible. The procedure was probably identical to that just described, and two very precise figures are on record. In both cases the height was taken not from sea level but from some inland point which cannot be precisely located, and the accuracy is therefore uncertain. Before 168 BCE a certain Xenagoras gave the height of Mount Olympus above the town of Pythion as 1,951 m. Since the highest summit of Olympus is not visible from Pythion, he was probably measuring a nearer and lesser summit. If so, his result was, arguably, 5% in error. A little later the height of Kyllene in the Peloponnese was given as 1,703 m. From the most likely starting point, this represents an error of only 2%. Despite the difficulties of surveying in mountainous terrain, where it is hard to find reasonably level ground to lay out the base lines and triangle, these results seem impressive.[18]

Another instance, albeit less clear cut, concerns the intended canal across the Isthmus of Corinth.[19] To cut this could never be an easy undertaking, because the isthmus is over 6 km wide and rises in a ridge of solid rock nowhere less than 79 m above the sea. But a canal would save ships the long and dangerous voyage around the Peloponnese, and the project was dreamed of by a succession of rulers; work was actually begun by the emperor Nero in 67 CE. Even so, we are told, it was then stopped because surveyors had found that sea level was higher at the western end than at the east, and it was feared that the island of Aegina would be inundated by the resulting torrent. The sources in question, however, are unreliable, and in all likelihood they are anachronistically applying to Nero's attempt a story more reliably reported for an earlier one. Eratosthenes the geographer records that about 303 BCE Demetrius Poliorcetes, a Hellenistic warlord, "attempted to cut through the Isthmus of Corinth to provide a passage for his fleets but was prevented by the engineers, who took measurements and reported that the sea in the Corinthian Gulf [to the west] was higher than at Cenchreae [to the east], so that if he cut through the land between, the whole sea around Aegina, Aegina itself, and the islands nearby would be submerged, and the passage would moreover be unusable."[20]

The engineers were essentially correct. Tidal effects, exacerbated by winds, mean that the sea level west of the isthmus is always higher than that on the east, with a maximum difference—we now know—of 51 cm. There is consequently a permanent current of up to 4.8 km per hour through the modern canal, which was completed in 1893. This causes little practical difficulty, and Aegina is still there. The canal being 6.342 km long, its surface has a maximum gradient of 1 in 12,435 (0.008%), thus comparable with the

gentlest gradients on Roman aqueducts, which must have taxed the skills and instruments of their surveyors to the limit. Demetrius's surveyors can only have leveled from sea level up to at least 79 m on the ridge and down again, at a date when dioptras, at least in their developed form, did not exist. It is all too easy to hail their result as a triumph. But it is not recorded what they supposed the difference in sea level to be. If it were known that they found it to be a cubit (roughly 50 cm), a triumph it could very well have been. But would so small a difference have raised fears for the safety of Aegina, 35 km away? Had the surveyors found it to be, say, 6 cubits (roughly 3 m), that would have been a massive error, which could just as easily have been in the opposite direction and made the eastern sea higher than the western. Such a finding would have been written off by posterity as a failure. We have to conclude, regretfully and at the risk of doing Demetrius's engineers a grave injustice, that their survey was probably not very accurate, and that it was only chance which made them err in the right direction.

Short distances were measured by chains, the most reliable method; or by cords, which were cheaper but liable to stretch or shrink; or by wooden rods of standard length (with metal ferrules to protect their ends) tediously leapfrogging each other. Even so, throughout antiquity and long thereafter, measuring long distances—several miles, or hundreds—was inordinately difficult. Alexander the Great on his conquests far into Asia employed "bematists," pacers, who counted their paces as they marched and noted the direction of travel and the names of places passed.[21] From their records, outline maps were compiled and descriptions of the routes published. The result was a vast improvement on anything that had gone before, but there remain severe limitations to the accuracy of pacing. It is notoriously difficult to maintain a straight path and an even pace through forest or swamp.

Geographers could reckon the distance between places on the same meridian by observing stars with the dioptra, just as was done later with the great medieval instrument that was its direct descendant, the astrolabe. The method was comparable to that of Eratosthenes, but in reverse. Geographers found a star which at a given time is vertically overhead at A, and at B, at the same time, they measured its angular distance from the zenith by means of the degree graduations on the dioptra. Here too, simple geometry gives the angle at the earth's center subtended by the radii to A and B, expressed as a fraction of the full circle. The distance between A and B is that same fraction of the earth's circumference, which the geographers thought they knew.[22]

An alternative and more flexible approach to long-distance measurement was offered by the hodometer. This fiendishly clever geared cart, arguably invented by the great scientist Archimedes of Syracuse in the late third century BCE, is described by Vitruvius (fig. 5.9). Every mile (or whatever distance was calibrated), it dropped a ball into a metal bowl with an audible clang; and at the end of the stretch concerned the balls were counted. The hodometer is mentioned occasionally in our ancient texts, but it was certainly not an everyday part of the ordinary surveyor's equipment, if only because of the virtual impossibility of driving it in a straight line across country. It could find distances along roads, although (except on certain Roman roads) they would rarely be straight-line distances. Thus, it could provide raw material for official or semiofficial records such as Agrippa's world map, the so-called Antonine Itinerary, and the Peutinger map, all of which included such information, as well as for geographers like Marinus of Tyre and Ptolemy who were concerned with coordinates for mapmaking.[23] In a similar way, in the seventeenth century, before milestones were in place, John Ogilby measured all the main roads of England and Wales with the "waywiser," or "wheel dimensurator,"

which was the hodometer's lineal descendant.[24]

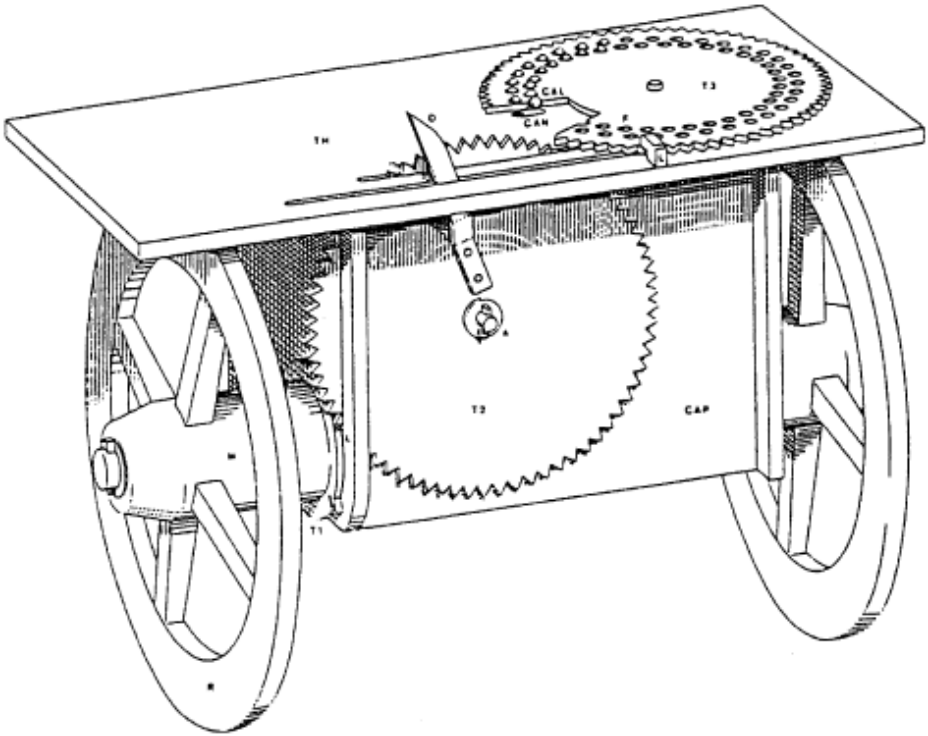



FIGURE 5.9 Hodometer reconstructed. Reproduced from A. W. Sleeswyk, "Vitruvius' Waywiser," *Archives internationales d'histoire de science* 29 (1979): fig. 1.

## Instruments and Their Uses by Romans

### THE GROMA

So much for the Greeks who, for all practical purposes, had only one instrument, the dioptra, for working in both the horizontal and vertical planes. The Romans, by contrast, had two different ones. While they certainly borrowed some theory from the Greeks, their instruments may well have had a native Italian origin.

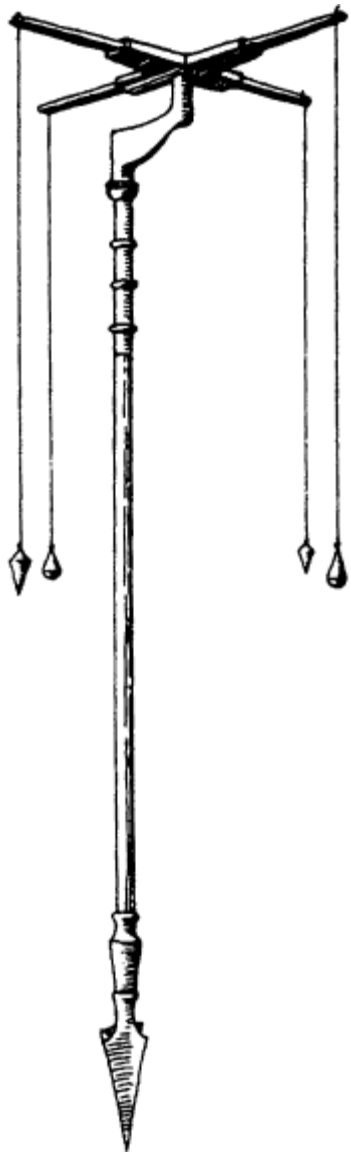


FIGURE 5.10 The Pompeii groma as reconstructed by M. Della Corte. After M. Della Corte, "Groma," *Monumenti Antichi* 28 (1922): fig. 13. Drawing by the author.

Let us look first at the *groma*, which was the exact counterpart of the dioptra in horizontal mode. Not only is it illustrated on two surveyors' tombstones, but the metal parts of one have also been recovered from Pompeii, the only ancient surveying instrument to have survived (Della Corte 1922). The principle is clear enough: a pole carrying a flat cross with a plumb bob hanging from each arm (fig. 5.10). Sighting across diagonally opposite cords gives a straight line which can be projected forward or back. Sighting across the other pair gives a line at right angles to the first. But the exact reconstruction is debatable, because it gives rise to two serious problems.[25] The first lies in the bracket carrying the cross, which seems to be a fantasy of the excavator. If there was no bracket, the cross was directly on top of the supporting pole, which would impede sighting across diagonal cords. The second problem lies in the fact that, to the

surveyor, the further cord necessarily appears to be thinner than the nearer. Unlike the slit sights of the dioptra, where the further slit can easily be centered in the nearer, on the groma the further cord is hidden behind the nearer and accurate alignment seems impossible. No satisfactory solution to either problem has yet been proposed. In addition, the long plumb lines of the groma were prey, even more than the dioptra, to swinging in the wind, so much so that Hero of Alexandria proposed shielding them in tubes.

Nonetheless, the groma was indisputably the tool of the *agrimensor*, the land surveyor, for whom a whole volume of practical manuals, terse and difficult, survives in the *Corpus Agrimensorum*.[26] It is illustrated with many maps, mostly schematic and hypothetical rather than factual, and all corrupted by copying. The agrimensor's principal job was "centuriation," dividing land for allotment into a grid of squares, each usually 2,400 Roman feet on a side, and subdividing them further. He also drew maps of the resulting plots for registration with the authorities, he set up boundary marks, and he arbitrated in consequent disputes. In Italy and North Africa especially (fig. 6.1 below),[27] there are hundreds if not thousands of square miles of centuriated land still marked by roads and field boundaries, the exact counterpart of the "hundred squares" of America. With a groma and measuring cords or rods, centuriation as such was hardly a difficult task.

However, it also seems that the groma was used in setting out long, straight alignments. Staking one out by interpolation between two intervisible points is quite easy, and no instrument is needed (fig. 5.11, *a*). A surveyor at one end directs men in between to move poles this way or that until they are in line with the other end. At close range he might direct by shouting; at longer, by signaling with flags. At extreme ranges, more laboriously, fires in the form of portable braziers might be necessary. If a hill lay between the two points, setting out would be done with a groma on the hill, moved sideways by trial and error until its cords were aligned with both end points (fig. 5.11, *b*). Or a given line can be extended by extrapolation, either by sighting forward and directing where the poles should go (fig. 5.11, *c*) or by sighting back with a groma and locating it on the alignment by trial and error (fig. 5.11, *d*).

**ROADS**

It is natural to turn next to Roman roads. In mountainous country the Romans had the good sense to fit their roads to the landscape in order to avoid impossible gradients. But on more gentle ground, many of their roads are renowned for running straight as an arrow over hill and dale, mile after mile. When they do change direction, it is usually on a high point, which is understandable. But how were long, straight alignments set out between two low-lying towns and across a number of intervening ridges? Ancient literature is silent on this puzzle. Roman surveyors had no preexisting maps to guide them, or none that were anything like accurate enough, and they had no magnetic compasses, although they may have had a better sense of the lie of the land than is usual today.

There are many theories about the method that Roman surveyors might have used. One is "*successive approximation*, in which a rough solution is refined by trial-and-error, until sufficient accuracy is achieved."[28] But how in practice might this be done? How does one bring into line marks on a succession of hilltops which might be 20 km apart, and where visibility extends only from one hilltop to the next, or to a terminus? In these circumstances, while it is straightforward to bring any three marks into line by interpolating the third between two previously fixed ones, to align (say) four marks between two fixed ones is a problem of a totally different order. The three marks at one

end can be brought into line with each other and with the three at the other end; but how to align the two resulting alignments? It can be done, but only by laborious and lengthy trial and error. At least this method may account for roads which run in a succession of straight doglegged alignments; only one hill intervenes between the ends of any particular leg, each alignment being established merely by a groma on the intervening hill.

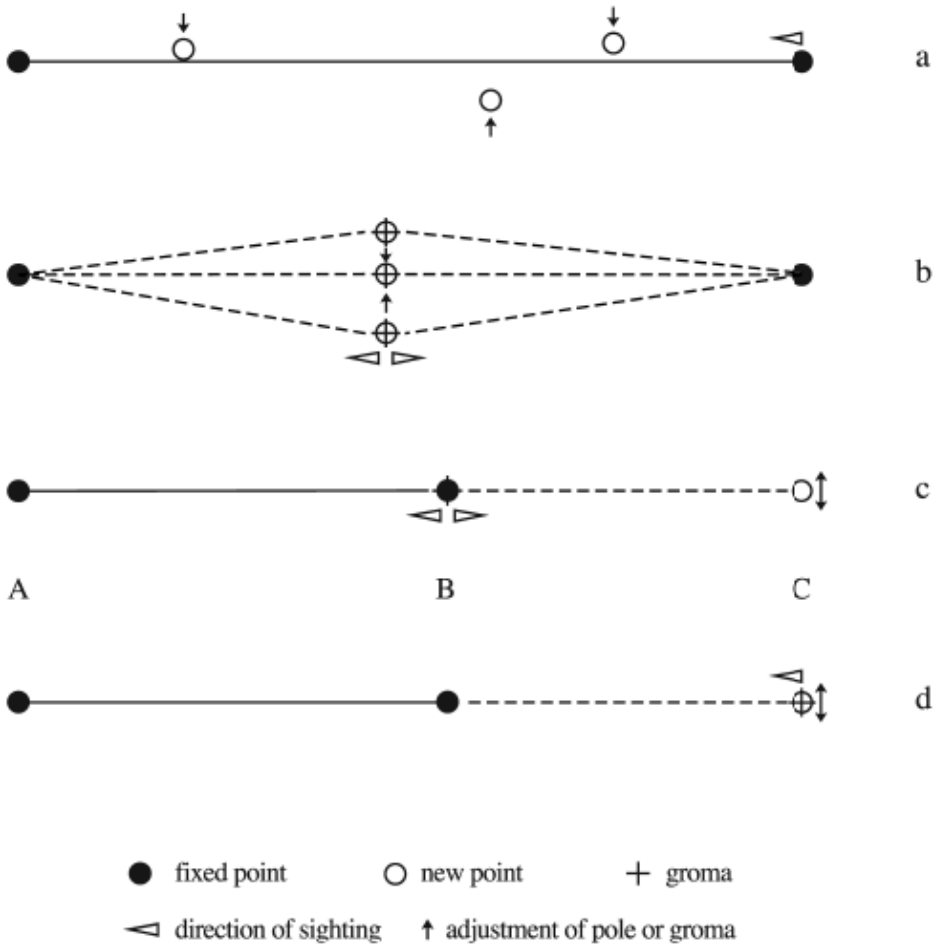



FIGURE 5.11 Simple alignment by interpolation (*a–b*) and extrapolation (*c–d*). Drawing by the author.

An alternative suggestion is that of dead reckoning, whereby a series of traverses at right angles to each other are set out by a groma: due east from a terminus, for example, then north, then east, and so on until the other terminus is reached. Each traverse is measured on the ground, and features such as swamps and forests are located by setting out and measuring offsets to them. All this information is transferred, true to scale, to a temporary large-scale map laid out perhaps on the floor of a room. On this map the actual route is planned and then marked, whether as a single straight line or doglegged to avoid forests or swamps. Points along the route are located on the map by offsets from the original survey line, and the length of each offset and its distance along the survey line are measured and scaled up to full size. The surveyors then set out these new offsets

and locating points on the ground. These points, when joined together, mark the route of the road. With this scenario, however, many problems emerge. Unless the map is fully contoured, any changes of direction will occur at points determined only in plan, not according to height, and (except by chance) they will not coincide with high points; thus, a conflict with observed fact is created. Moreover, since the initial survey has to be done on the ground and the road has to be built there too, to design it from a laboriously compiled map would seem to introduce an unnecessary and potentially misleading intermediate stage. It divorces the surveyor from the field, where he can see how well his route fits the terrain much better than he can in the office. Above all, there is the difficulty of measuring long distances across country with any accuracy. Errors will inevitably be made and transferred to the map. Further errors will arise in transferring the chosen route back to the ground.

A vastly simpler method would be to start off from one terminus for the road, marking out by a groma a straight line in the direction which aims, at the best guess, at the other terminus and measuring the distances along the way. Suppose this line misses the destination by 4 miles to the east. At the halfway point as measured, the alignment therefore needs to be moved west by 2 miles, at the three-quarter point by 3 miles, and so on. The operation would be much faster than by successive approximation or by dead reckoning; but it is still unsatisfactory because it involves measuring the whole route.

Instead, I propose another theory. It depends, like so much ancient surveying, on similar triangles. Let us suppose the surveyor wants to stake out a direct route from A to B, which he knows lies roughly east of A, and his best guess is that it lies a little north of east. By extrapolation he projects a line AX in that direction, sighting from high point to high point (fig. 5.12). When it becomes clear that his line passes well north of B, he returns to A and projects two new alignments AY and AZ further to the south, designed to bracket B, and he stakes them out as he goes. Then from B he projects two lines back on the reciprocal bearings until they intersect AY and AZ at C and D. The diagonal between C and D is measured, and the point E halfway along it is marked. Because ACE and BDE are identical triangles, as are ADE and BCE, AEB is a straight line. To fill in further points on this line, the same process can be repeated on a smaller scale or can be interpolated in the usual way, as the terrain directs. It would be a laborious job; but with the means at the surveyor's command, any method would be laborious. My theory is no more than that, but it seems plausible, and the cross-country measurement involved is minimal—only from C to D.

Use of the word "bearing" begs a question, however. Today we take bearings by various means, such as measuring them on a map or using a magnetic compass. In Roman times neither means was possible. So how did Romans deal with bearings? As far as we can tell, terrestrial surveying simply did not measure angles in degrees. There were of course terms for the cardinal points, but not for divisions between them like our south-southwest, for example, which means precisely 202½ degrees. Instead, Romans described an angle in terms of the sides of the right-angled triangle which subtends it. It is more convenient if one of these sides is aligned north-south; as we have noted, a north-south line could be established with great accuracy.

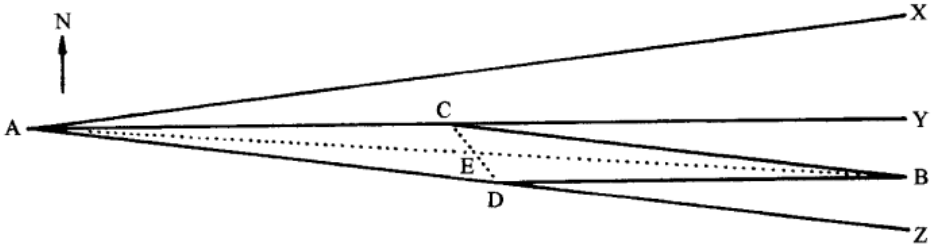


FIGURE 5.12 Surveying alignment by geometric construction. Drawing by the author.

Let us consider the same diagram, but opened up for greater clarity (fig. 5.13). I suggest that when the surveyor set out the lines from A he recorded their direction as exactly as he could, by setting out on the ground a north-south line and linking it to their alignments with right-angled triangles (as large as practical), which he then measured. Thus, the direction of AY is easy—due east, where the ratio of the triangle's sides is 1 to 1. For AZ, the ratio is (let us say for the sake of simplicity) 1 to 2—that is, 1 unit south from A and 2 units east. For setting out the return lines, the surveyor used the reciprocals. BD is easy again—due west. BC is the reciprocal of AZ, namely, 1 unit north from B and 2 units west.

As an illustration (fig. 5.14), Stane Street in Britain is the Roman road from London (Londinium) to Chichester (Noviomagus), 80 km away and separated by a number of ridges (*BAtlas* 8G3–G4). For the first 20 km from London (L) the road aims exactly at Chichester's east gate (C). Thereafter it diverges for very good geological reasons. But the Romans had clearly worked out—by the method just outlined?—what we would call the bearing, that Chichester lies 20 units south of London and 13 units west. In modern terms, 13/20 is tan 33 degrees, and we would say that Chichester lies 33 degrees west of south from London, or 213 degrees relative to north. Although less cumbrous, our modern system comes to exactly the same thing.

The ultimate straight alignment, surely the longest of the ancient world, is the Roman frontier established between the rivers Main and Rems in Germany in about 155 CE. Over a distance of 81.259 km its palisade and ditch deviate only once, for a distance of 1.6 km, to avoid a deep valley (*BAtlas* 12C3–C4). This apart, a very precise modern survey of the southern part reveals that the mean deviation from a truly straight line was ± 1.9 m. Why the frontier was made so painstakingly straight (military perfectionism run riot?) is perhaps hardly relevant to us. Of greater concern is how it was set out in country that was probably even more heavily wooded than it is today. All the methods rehearsed above would have been difficult or, if they involved measurement, impossible. The most likely answer is the simplest possible: that the precise location of the ends of the alignment was unimportant, and that the setting out began with a chosen alignment between two high points which was extrapolated in both directions.

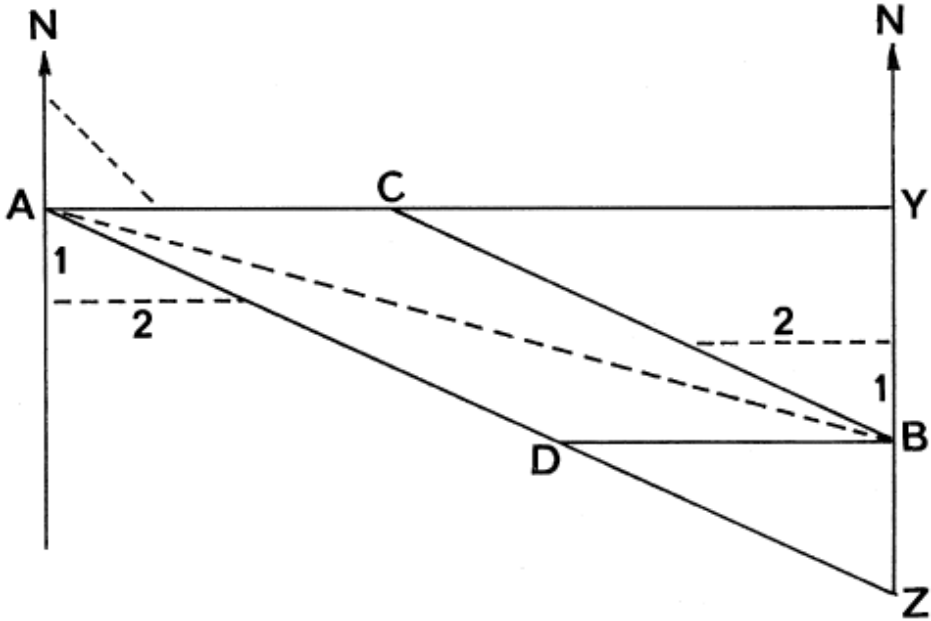



FIGURE 5.13 Recording bearings by triangle sides. Drawing by the author.

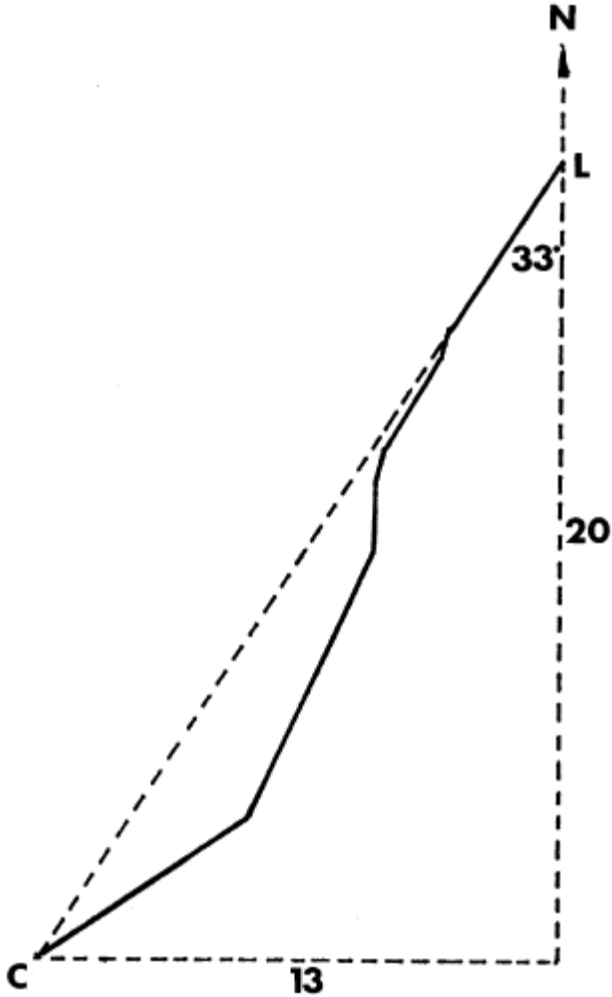


FIGURE 5.14 Stane Street. Drawing by the author.

**THE LIBRA**

In the vertical plane the Romans worked with the *libra*. We know deplorably little about it (Lewis 2001, 109–19). There is no surviving description or illustration. It does not feature in the *Corpus Agrimensorum*, which for all practical purposes is unconcerned with altitudes. As a surveying instrument, the libra is in fact mentioned only once, by Vitruvius (8.6.3): "leveling is done with dioptras or *librae aquariae* or the chorobates." It is often assumed that *libra aquaria* means a water level like that on the chorobates or Hero's dioptra. But beyond these two instances there is no evidence for the water level in the Greek and Roman world, and taking a true horizontal off a water surface, unless it be impractically long, is almost impossible. It seems therefore that the *libra aquaria* was not a level leveled by water, but a level for leveling water—in other words, an aqueduct level.

Vitruvius's mention of the chorobates is, as we have seen, irrelevant to surveying, and his mention of the dioptra seems irrelevant to Roman surveying. We cannot dismiss his mention of the libra, however, because Latin had a number of words and phrases of the same derivation whose widespread use shows that the libra was well established long

before his time. *Ad libram* meant horizontal, *librare* to make horizontal or to take levels with an instrument, *libramentum* a gradient, *libratio* the taking of levels, *librator* a surveyor. Thus, Pliny the Elder in the first century CE describes aqueducts for bringing water to gold mines in the Spanish mountains (*NH* 33.74–75): "Gorges and crevasses are crossed on masonry bridges. Elsewhere impassable crags are cut away to hold wooden troughs. The workmen, hanging on ropes to cut the rock, look from a distance more like birds than beasts. It is usually suspended like this that they take the levels (*librant*) and mark out the route, and man brings water where there is not even room to plant his feet." This circumstance more or less rules out the water level and the A-frame level, which have to be placed on a solid surface, and it strongly implies a self-suspended level that can be held in the hand or even hung from a rope in front of the surveyor.

This interpretation also accords with the history of the word *libra* itself, which from its basic meaning of a weight came to denote a pair of scales or a balance, as in the sign of the zodiac. Here lies the major clue to the form of the instrument. To weigh accurately, the beam of a balance must be exactly horizontal, and it seems reasonable to deduce that this was the imagery behind the name of the surveying instrument. A libra for leveling was therefore made on the lines of a balance beam: a long iron alidade with projecting slit sights at each end, suspended from a knife-edge above its center (figs. 5.15 and 5.16). In principle it is identical to the dioptra in vertical mode. But its surface area is so much less that it hardly moves in a wind. Indeed, it is so finely suspended that a fly settling on one end affects the reading on the staff. And because it is so much longer—1.83 m—it is much more accurate. Tested against a modern level, once again reversed to take double readings to counteract any in-built imbalance, its average error over the same course of 173 m was 1 in 57,000 (0.00175%), compared to the dioptra's 1 in 1,418 (0.07%). The best result was identical to that achieved with the modern level. This was a relief, because while, as we have noted, the dioptra is good enough for setting out the steep gradients of ordinary Greek aqueducts, this libra—although its design is very much more conjectural—could reasonably survey the extremely shallow gradients found on Roman ones.

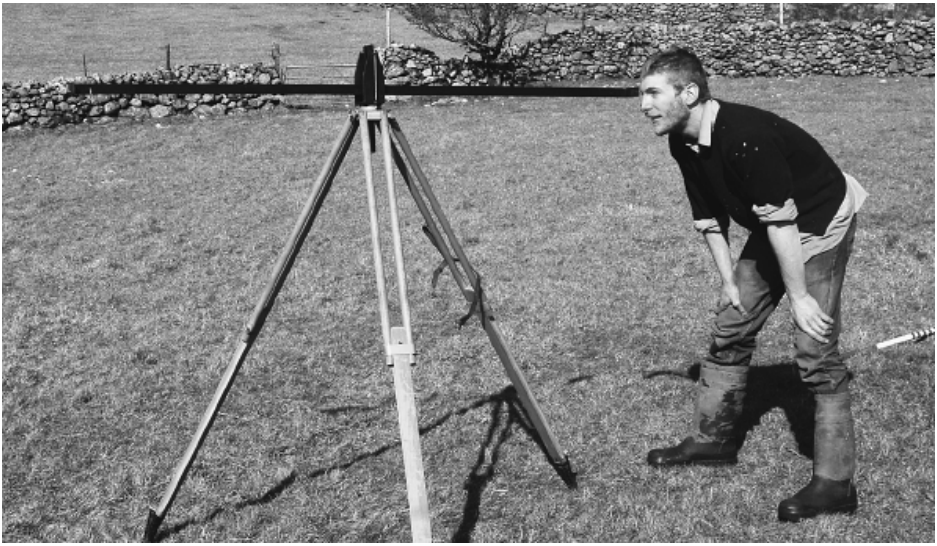


FIGURE 5.15 Reconstructed libra. Photograph by the author.

FIGURE 5.16 Reconstructed libra, detail. Photograph by the author.

## AQUEDUCTS

Where the libra's origins lay, and the stages of its evolution, we cannot tell and probably will never know. Surviving Latin literature does not go far enough back. Conceivably the libra was inherited from the Etruscans, conceivably it was a truly Roman invention. But it does not seem to have been, so to speak, the alidade borrowed from a Greek dioptra, because it would appear that it existed before the standard dioptra evolved. The gradient of the first aqueduct supplying the city of Rome, the Aqua Appia (312 BCE), is not known. That of the next, the Anio Vetus (269 BCE), averages about 1 in 370 (0.27%) overall but, as is usually the case, varies, and it includes kilometer-long stretches at about 1 in 5,000 (0.02%).[29] Over such distances, so shallow a gradient seems to have been deliberate rather than accidental, and it is too shallow for a dioptra to have achieved.

This is not to say that very shallow gradients are to be found on every Roman aqueduct. There is no particular virtue in them. On the contrary, other things being equal, it is easier to lay out an aqueduct on a steeper gradient because surveying errors can be more readily accommodated, whereas with a very small slope an aqueduct can be rendered unworkable by the slightest of mistakes. What dictates the gradient is the local geography, namely, the height of a suitable source of water above the destination and its distance along a practicable route. In hilly and well-watered country the difference in height is likely to be considerable, the distance short, and the gradient therefore relatively steep; in flatter terrain, the reverse. The Greeks were happy with steep gradients because their aqueducts were usually pipelines which could not overflow. Roman aqueducts had open channels—in minor cases literally open, but usually lined

and vaulted over to keep the water clean—so that on steep slopes overflowing was a potential problem. Consequently, if a steep gradient was forced on Romans by the terrain, they often introduced cascades: vertical steps separated by relatively level sections, which killed the velocity of the water. Cascades apart, if one had to guess at a "usual" gradient, it would be somewhere between 1 in 333 and 1 in 1,500 (0.3 and 0.066%).[30]

This is the context in which to view Vitruvius's much-debated statement (8.6.1): "Let the bed of the channel have a minimum gradient [*libramenta fastigata*] of half a foot per 100 feet [*in centenos pedes semipede*]," that is, 1 in 200, or 0.5%. The inevitable corollary is that the average gradient was steeper and the maximum steeper still. Outside Greek lands, this is simply inapplicable to the Roman aqueduct, on which 1 in 200, far from being the minimum, was more like the maximum. The favorite explanation of this anomaly is that Vitruvius's figure has been corrupted in the manuscripts. This line of argument finds support in Pliny the Elder's section on aqueducts (*NH* 31.57). In all other respects it closely follows Vitruvius, but it states that the minimum gradient should be 1 in 4,800 (0.021%), a figure nearer the truth for Pliny's own time. On the other hand, a later writer, Faventinus, who also drew on Vitruvius, goes further in the opposite direction and recommends a minimum of 1 in 67 (1.5%).[31]

These anomalies are readily explained. First, Vitruvius drew almost all his material on aqueducts not from his own experience, or directly from Roman sources, but from Greek ones which he did not fully understand. Indeed the precise source for his statement about gradients has apparently survived in a fragment of Philo of Byzantium, a Greek of the third century BCE who wrote, among much else, an almost entirely lost book titled *Water Conducting*. Vitruvius drew on Philo for other material too. This fragment, which survives in a medieval Arabic treatise, prescribes a minimum slope for irrigation channels of 12 fingers in 100 cubits, which again is 1 in 200.[32] Second, the contradictions between the Roman writers are simply resolved if Vitruvius's figure was not spelled out in words but given as an abbreviation, which (as so often happened with this ever-fruitful source of confusion) was miscopied or misread by later generations. I suggest that his *in centenos pedes S* (½ ft per 100 ft) was read by Pliny as *in centenos pedes* ɔ (¼ inch per 100 ft), and by Faventinus as *in centenos pede S* (1½ ft per 100 ft). If so, there is only one statement from antiquity about minimum gradients. Originating with Philo, copied by Vitruvius, miscopied by Pliny and again by Faventinus, it really applies to unlined irrigation channels in the Middle East and has nothing whatever to do with built Roman aqueducts.[33]

Aqueducts are particularly difficult to survey because they have to be fitted to the landscape not only in plan but also in the third dimension. It does not matter if, within limits, a road goes up- and downhill. If an aqueduct goes uphill, however, it will not work—unless it is under pressure in pipes, as in the case of inverted siphons, which sometimes carried them across valleys. On the question of how aqueducts were planned, Greek and Roman literature is virtually silent, just as it is about how roads were planned. The surveying manuals, useful though they are, always focus on the relatively small problem and never on the larger challenge. However, common sense suggests that the operation involved three distinct stages.[34]

First, springs of suitable volume and quality had to be located, ones which seemed to be high enough for their water to flow by gravity to the town; at the other end, a site

had to be chosen for the receiving tank at, ideally, a point high enough to supply the whole of the town. Second, the exact difference in height between these two end points had to be discovered by meticulous leveling, and if that difference, taken in conjunction with the likely length of the channel as demanded by the terrain, gave a reasonable gradient, then the surveyors could proceed to the third stage.

This stage was to set out the route on the ground so that, in the interests of cost, it was as short as possible, demanded a minimum of expensive engineering works such as tunnels or arcades, and had a gradient as constant as the shape of the land allowed. These requirements often conflicted. To save heavy engineering, the length of the route might have to be greater, but then a gradient which was acceptable on a more direct line might become unacceptably shallow on a longer route. The work for this stage was no doubt divided into several phases, the first defining a few key intermediate points, the subsequent ones progressively filling in more and more detail. In every phase there would be alternative routes to be considered, advantages and drawbacks to be balanced, and compromises to be reached. The surveyors, moreover, must have had to build up their own maps as they went. For certain, on a long and difficult aqueduct the whole process would take a great deal of time and fieldwork. One is reminded of Robert Stephenson who, in determining the best route for the London & Birmingham Railway in 1831, walked the full distance (181 km) more than twenty times (Smiles 1862, 306).

We know that the surveyors, their work done, left the route marked out with stakes. Presumably the same or different stakes were also marked to indicate the levels. It was then for the builders to take over. But how accurately could they, or did they, follow such marks? Although there is no evidence, it seems likely that (then as now) they used boning or sighting boards to maintain a given gradient. These consist simply of two pieces of wood nailed together in the shape of a T. Someone sights from one surveyed level mark to the next; in between, boning boards are driven into the ground along the route or beside it, until the top of each T coincides with the line of sight. The floor of the channel is then built up to this level. On the Eifel aqueduct supplying Colonia Agrippinensis (*BAtlas* 11G2, modern Cologne in Germany), constructional differences and changes of gradient suggest that contracts were let for lengths of about 3 Roman miles, and steps in the floor (the biggest is 35 cm) at each end of one such section show how gangs had failed to match their work with that of their neighbors. It was clearly possible for surveyors' careful work to be marred by shoddy work by the builders.

It is the shallowest-graded aqueducts which provide the best yardstick of the capabilities of the libra, and that at Nemausus (*BAtlas* 15C2, modern Nîmes in France), which incorporates the renowned Pont du Gard, is perhaps the most instructive (fig. 5.17).[35] The source lies 14.6 m higher than the receiving tank in the city and 20 km away as the crow flies. On a direct line the gradient, if constant, would be 1 in 1,370 (0.073%). How close the Roman surveyors got to this theoretical figure there is no way of telling, nor can we know along what line they took their preliminary levels. But, assuming their work to be accurate, they would know that in no circumstance could the overall gradient be steeper than 1 in 1,370. In fact, anything like a direct route is totally forbidden by the upland massif of limestone which intervenes: tunnels through it would be impossibly long. The only practicable route skirts the upland in a great bow which more than doubles the distance to 50 km and more than halves the overall gradient to 1 in 4,000 (0.025%). The length is considerable, but far from a record—the longest of the aqueducts supplying Constantinople (modern Istanbul in Turkey) reaches a phenomenal 336 km.[36]

Ideally, height should be lost consistently: when the channel had run a quarter of the total distance, it should have lost a quarter of the height available. But the actual gradient of the Nîmes aqueduct is far from constant. Apart from many localized variations, the top section is relatively steep—at an average, 1 in 2,542 (0.04%). This section ends at the Pont du Gard, which is sited at the best point (in engineering terms) for crossing the valley of the river Gardon (fig. 5.18 and plate 5). As built, 47 m high above the river, it is the tallest bridge, as far as we know, ever undertaken by the Romans. Perhaps the engineers decreed "so high but no higher." However, in fixing its height well below the overall gradient, they gave the surveyors the luxury of a steeper gradient above it, but the penalty of a shallower one below. At the Pont du Gard they had used up about half of the height available in only about a third of the distance. Put more starkly, they still had 34 km to go and only 6 m of height left at their disposal.

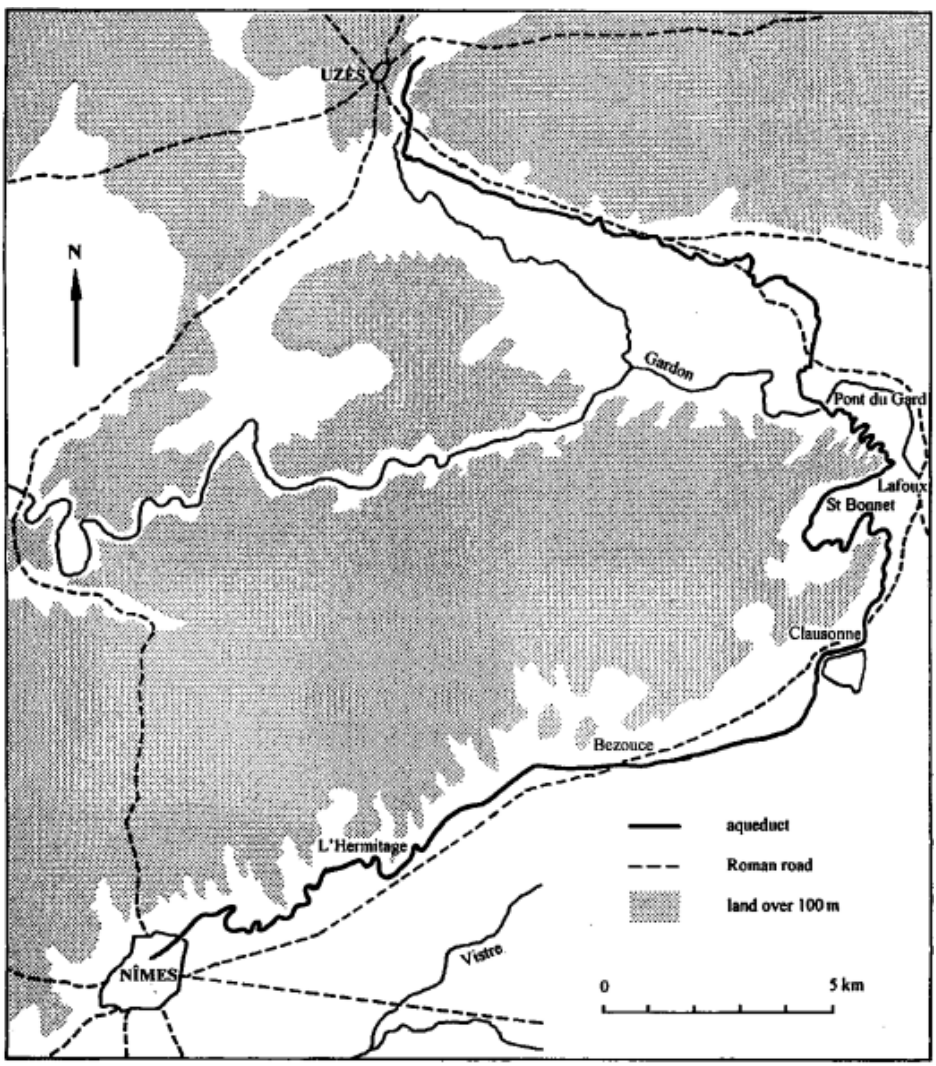



FIGURE 5.17 Nîmes aqueduct. Drawing by the author.

For the 5 km immediately below the Pont du Gard the ruling gradient is almost 1 in

8,000 (0.0125%). Here a succession of small valleys descends from the upland, and the channel negotiates them by means of a series of reentrants with hairpin bends at each end (fig. 5.19). Presumably the cost of tunneling through the spurs or bridging the valley entrances, which would have shortened the distance and helped the gradient, was considered too great. In this broken terrain, where the route is so tortuous that rarely can one see more than 100 m of it at once, surveying must have been a nightmare. Small wonder that the gradient changes frequently; at one point, indeed, it actually runs uphill, climbing 4.4 cm in 1,608 m. The effect on the water flow would be little worse than if it were level, but, whether the surveyors or the builders were responsible, it cannot have been intended. Space forbids detailed analysis of the rest of the route; but two stretches of roughly 8 km each are at virtually 1 in 20,000, or 0.005%, a fall of only 5 cm per kilometer.

FIGURE 5.18 Pont du Gard. Roman aqueduct (UNESCO World Heritage Site, 1985) on Gardon River. Photo: S. Vannini. Pont du Gard, Nîmes, France. © DeA Picture Library/ Art Resource, NY.

The aqueduct had its teething troubles. Typically, at points where a steeper slope meets a gentler one below, water slows down, backs up, and may overflow. That happened in this case, and considerable lengths of the vaulting had to have their walls heightened, as did the trough of the Pont du Gard itself. But in the end the system worked, if only just. One is tempted to wonder if it did so more by luck than by good management. The surveyors and their instruments were surely tested to their limits. Nonetheless, with gradients as shallow as these, the Nîmes aqueduct illustrates the extraordinary precision of which Roman surveyors were capable. Whether they were fully aware of how fine the tolerances were, how close they were to failure and shame, we shall never know.

There are only two known instances of aqueducts which did not work. One is at Lindum (*BAtlas* 8G1, modern Lincoln in Britain), where there is no sign that water ever

flowed along its pipeline, but Lincoln was very much an oddity, in that its source lay 30 m *below* the tank in the city. The intention must have been to push the water up by machine—we know of two other cases where this was done—and most probably the machinery proved inadequate. It was hardly a surveyor's error (Lewis 1984). In the other instance, recorded in literature rather than by archaeology, the finger of suspicion does point at the surveyor. Pliny the Younger reported to the emperor Trajan in 112 CE that Nicomedia in Asia Minor (*BAtlas* 52F3, modern Izmit in Turkey) had made two attempts at building an aqueduct, and that both had been abandoned and largely demolished. Please send me, he asked, a surveyor or engineer "to prevent a repetition of what has happened" (*Letters* 10.37). The problem sounds like an engineering one, and of engineering problems the most likely is bad surveying. Our confidence in the surveyors of Nicomedia is not improved by their claim, also reported by Pliny (*Letters* 10.41–42, 61–62), that a nearby lake was less than 20 m above the sea. In hard fact, the lake surface averages 32 m above the sea, which is about 20 km away. If the local surveyors were as inaccurate as that, one can readily believe that they were responsible for the aqueduct fiasco.

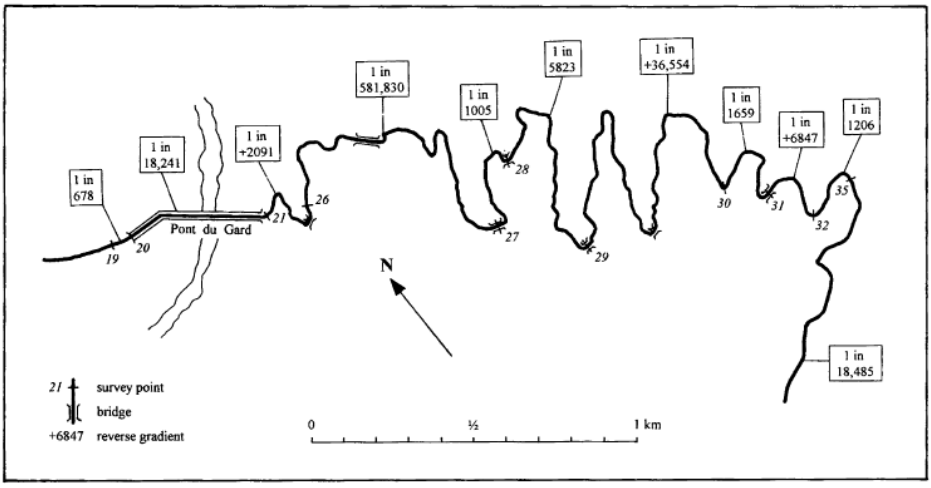



FIGURE 5.19 Hairpins on Nîmes aqueduct. Drawing by the author.

## TUNNELS

The surveying and driving of tunnels must count among the most difficult of engineering projects. Not only are conditions of work underground unpleasant and dangerous, but to establish and maintain the required gradient and alignment through solid rock also demands skills of a high order. The tradition of tunneling goes back to at least the eighth century BCE in Persia, where qanats, often several kilometers in length, brought water from underground aquifers to the surface for irrigation (Goblot 1979). These were probably the inspiration, either directly or through Egypt, for a small group of archaic Greek tunnels in the sixth century. Meanwhile, numerous tunnels (*cuniculi*) were dug in Etruria, most of them to drain waterlogged valleys; possibly they, too, reflected Persian practice transmitted through Greece. Later, the Romans adopted tunnels on a truly ambitious scale, for draining lakes, carrying roads, and above all as components of aqueducts.[37]

Some tunnels, like the qanat or the mine adit, were single ended, with only one

mouth opening to the surface. Most were through-tunnels which passed through an obstruction such as a mountain ridge. These were of two sorts. The more difficult was the two-ended tunnel, where the depth of rock above was too great to sink shafts, except perhaps near each end for the purpose of alignment. The best known example, 1.036 km long, is that built about 530 BCE by Eupalinus to bring water to the town of Samos in the Aegean (*BAtlas* 61D2). The longest of all, on the Anio Vetus aqueduct near Rome (*BAtlas* 43C2–D2), was about 2.25 km. Two-ended tunnels permitted only two working faces, where the available space severely limited the number of workers. In consequence such tunnels took a long time to complete, and the difficulties of ensuring that two long headings met were considerable.

In the other, much more common type, the shafted tunnel, a series of shafts was sunk from the surface and their feet were linked by relatively short headings underground (fig. 5.20). This technique, employed on the qanats, was adopted wherever possible thereafter. In terms of length it culminated in the Roman aqueduct supplying Bononia (*BAtlas* 40A4; modern Bologna in Italy), 20 km long and entirely in a shafted tunnel. Shafts allow easy removal of spoil, better ventilation and, once the tunnel is finished, access for maintenance. More important still, each shaft increases the number of working faces by two. Despite the extra material to be removed, shafts therefore speed up the work, and the headings, because they are shorter, are less at risk of missing each other.

The difficulties inherent in tunnel surveying are considerable. Both the alignment of the final route and its level (which by definition is still invisible and inaccessible) have first to be established on the surface, both have to be marked in such a way that they can be projected underground once work has begun, and finally both have to be followed as driving proceeds. Tunnelers cannot see where they are going, and the scope for error is very great. Even though alignment and level must have been decided and followed at the same time, they are best discussed separately. For alignment, the procedure deduced for the Samos tunnel serves as a good example. Once the location of the two mouths had been determined, a straight line between them was set out across the intervening mountain by interpolation or successive approximation. To project this line underground, two markers were needed at each end, and not too close together. Each mouth certainly acted as one marker, but both are on steep slopes. So at the northern end the second marker was placed, on the alignment, on the opposite side of the valley. At the southern end, where this was impossible, a shaft was sunk on the alignment just inside the mouth. As the two headings advanced, they were aligned by sighting backward on the northern mouth and marker and on the southern shaft and mouth, respectively.

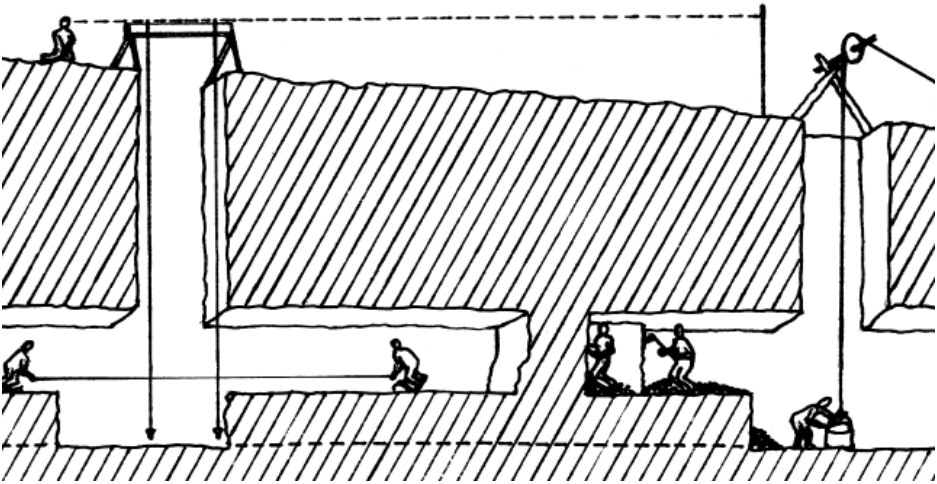


FIGURE 5.20 Shafted tunnel. After G. Fabre, J.-L. Fiches, and J.-L. Paillet, *L'aqueduc de Nîmes et le Pont du Gard: Archéologie, géosystème et histoire* (Nîmes, 1991), 85.

Whereas two-ended tunnels were almost always straight (or meant to be), shafted tunnels were often doglegged, the changes of direction occurring at shafts because it was down them that alignments were transferred. It seems likely that the ancient world used the method standard both on qanats and on more modern tunnels. A plank was laid across the shaft head and oriented precisely on the correct alignment. From it two plumb lines hung down to the shaft foot, where they necessarily assumed the same alignment. If the alignment changed at that shaft, similar planks and plumb lines also projected the new line down. The tunnelers, digging away from the shaft in both directions, followed the alignments indicated. As long as the tunnel mouth or the shaft foot could be seen from the working face, they knew the heading was straight. Usually a small pilot heading was driven first, later to be opened up to full bore.

Establishing the level was more difficult. The first step was to fix the relative heights of the mouths, allowing for the intended gradient. For a two-ended tunnel the surveyors might take levels over the hill to be pierced or, as probably at Samos, follow the contour around the hill. On shafted tunnels the process was more complicated, because the shaft heads lay at differing heights, but each had to be sunk to the correct horizon to meet the intended gradient underground. The surveyor would therefore level the site of each intended shaft on the surface, and from the height thus obtained and the distance along the line of the tunnel he would calculate the depth required. Maybe he drew a longitudinal section to scale and measured off the depth. Maybe he made all the shafts of equal depth below some horizontal datum, while allowing for the gradient. The traditional qanat surveyor measured the depth of one shaft with a knotted cord. He leveled from this shaft to the next one uphill, added to the cord the difference in height, and subtracted from it the height which the prescribed gradient should climb along that interval. The resulting cord was the depth of the next shaft (Hodge 1992, 205–6).

While a tunnel was under construction, the engineer had to keep a very close eye on the progress of the work. Above all, to ensure that the headings met up, he needed to know how far they had progressed and to what extent, if any, they had deviated from the intended line. It was easy to measure how far they had gone, but much harder to estimate on the surface how far they still had to go. While it was unlikely that long headings would achieve a neat, head-on meeting, it was possible to adjust their

alignment in order to ensure that they would at least intersect. If one or both were deliberately angled so that their directions converged, they would be certain, provided the levels were correct, to meet. Much can be deduced from the Samos tunnel (Grewe 1998, 58–69). As the headings approached each other, Eupalinus opted for safety and made the northern heading zigzag to the west. On its return eastward (fig. 5.21, *a*) it crossed the original alignment at an angle and should have met the southern heading. But, as we now know, this was still 140 m away. Eupalinus had played his hand too soon, which implies that he had underestimated the total length of the tunnel. He therefore continued the northern heading at the same angle and turned the southern heading eastward too (*b*). Still they did not meet. At this point he probably realized that his estimate of underground distance was astray, and so he turned both headings toward each other. This should have been the final move, for he had clearly kept a careful record of how far his deviations had departed laterally from the original alignment. What he still did not know was that the northern heading was out of line with the southern: over its whole length it pointed about half a degree too far to the east. Its face was therefore always further east than expected (*c*). By this stage, however, the tunnelers could probably hear each others' pick blows through the rock, and by driving a final curved hook they were united (*d*).

Mismatches are often to be seen in shafted tunnels too, usually minor but occasionally spectacular. In La Perrotte tunnel just south of Saint Bonnet on the Nîmes aqueduct, for example (fig. 5.22), two pilot headings, only 24 m in combined length, were 1.45 m out vertically and about 2 m out horizontally when they met (Grewe 1998, 161–70). Although the junction was smoothed out, it was shoddy work, and surprising because on this aqueduct, as observed above, every millimeter of fall was precious.

There seems no reason why ordinary instruments—the dioptra and libra—should not have been used for leveling tunnels in Hellenistic and Roman times, both to determine height differences between mouths and shaft heads on the surface and to maintain the gradient underground. The much thornier question is what the Greeks used before the standard dioptra evolved in the late third century BCE. If they (and even the Etruscans) borrowed the very idea of tunnels, directly or indirectly, from Persia, we might expect them also to have borrowed the instruments for surveying qanats. For this early date we have no direct information at all on the nature of those instruments. But we do know how medieval qanat builders worked, and given that theirs was a highly conservative and hereditary profession, it is conceivable that their instruments were much the same as those their predecessors had always used.

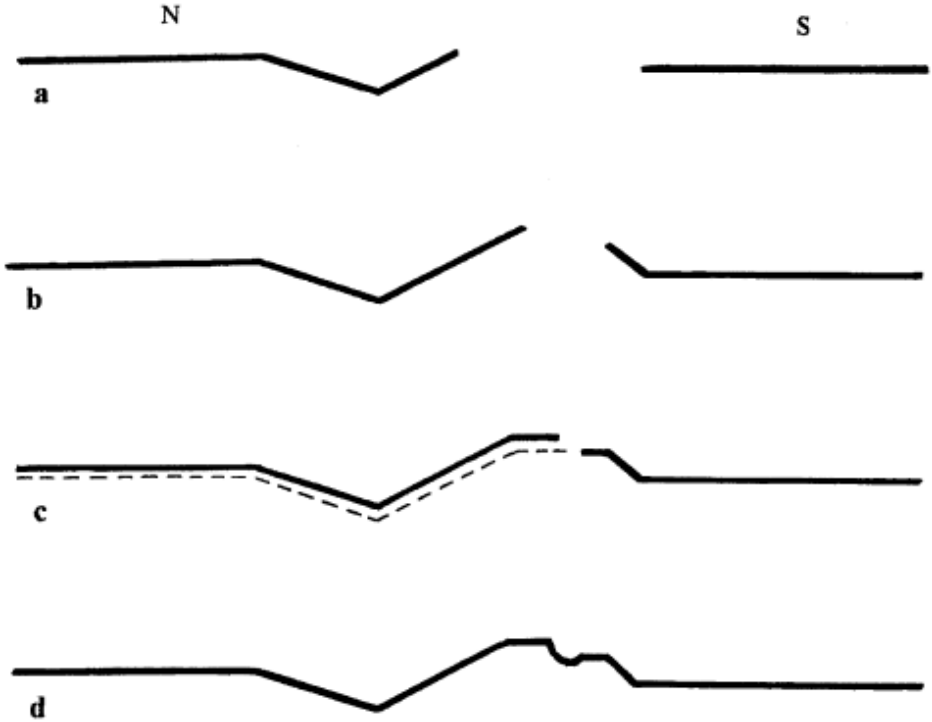


FIGURE 5.21 Samos tunnel, strategies for meeting. Based on K. Grewe, *Licht am Ende des Tunnels: Planung und Trassierung im antiken Tunnelbau* (Mainz, 1998), Abb. 88. Drawing by the author.

Medieval qanat builders leveled height differences on the surface with a *mizan*. It required two graduated staves and a cord from whose center dangled a plumb line and a plate carrying a vertical mark. The staves were held upright a cord length apart, the cord was stretched between the tops of the staves, and one end was lowered until the plumb line coincided with the mark on the plate. This showed that the center of the cord was horizontal and its ends were therefore at the same height; the difference in readings on the staves gave the difference in height between their feet (Lewis 2001, 251–53). For underground use there was what might be called a protodioptra. A hollow brass tube was suspended from the tunnel roof, and the level was maintained by sighting through it (al-Karaji 1940, 26). How the tube was made precisely horizontal we are not told; conceivably, as suggested for the standard dioptra, it was reversed and the mean of the sightings was used. Although there is no evidence whatever in the West for the use of the mizan or, in this simple form, of the sighting tube, these qanat procedures would be entirely adequate for most of the archaic Greek and Etruscan tunnels with their quite steep gradients.

The real crux lies in the Samos tunnel. Its floor was evidently meant to be horizontal and almost is: it actually falls only 4 cm in 1,036 m, the pipeline itself running at a much steeper gradient in a trench cut in the tunnel floor. To the burning question of whether qanat instruments were capable of the accuracy seen at Samos, the only possible—and wholly unsatisfactory—answer is that we know of nothing else that was available at the time and could have done any better.

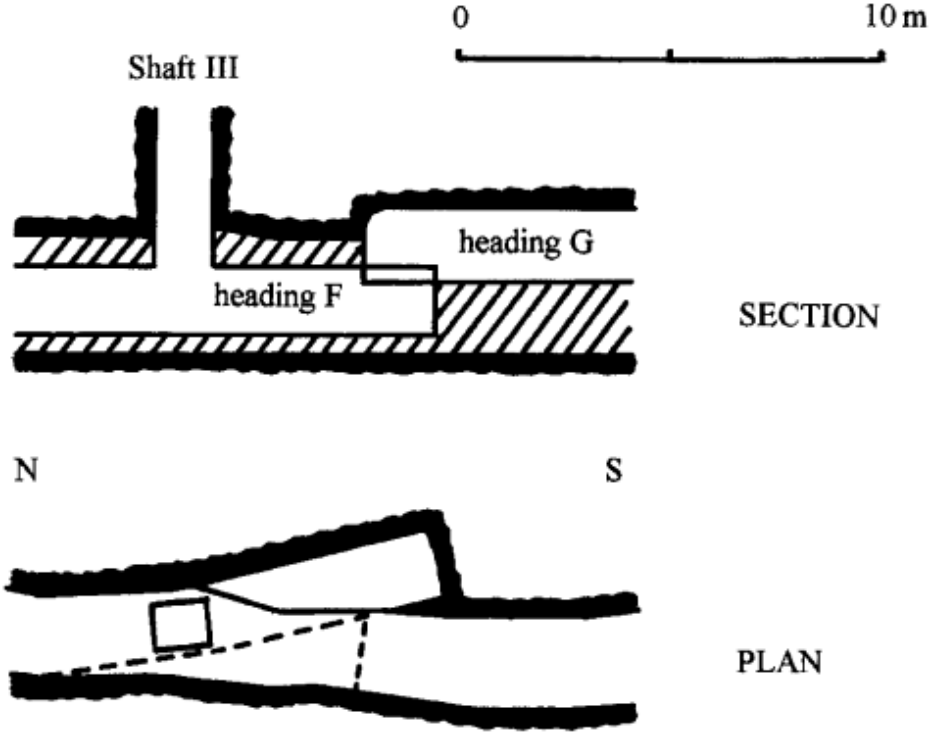



FIGURE 5.22 La Perrotte tunnel, Nîmes aqueduct. Based on K. Grewe, *Licht am Ende des Tunnels: Planung und Trassierung im antiken Tunnelbau* (Mainz, 1998), Abb. 257. Drawing by the author.

Tunneling, then, was full of challenges. At Saldae (*BAtlas* 31C3; modern Bejaia in Algeria) about 150 CE, a military surveyor named Nonius Datus was called in to rescue the municipal aqueduct project which had gone wrong—as we know from the inscribed record set up at the legionary base Lambaesis (*BAtlas* 34E2), in which Nonius himself explains: "I came to Saldae and met Clemens the procurator, who took me to the hill where they were bemoaning the poor quality of workmanship on the tunnel. It seemed that they were considering abandoning it, because the length of tunnel driven was longer than the width of the hill. The headings had evidently diverged from the straight line . . . but the straight line had been staked out across the hill." Nonius set things right, and the tunnel carries water to this day (Laporte 1997).

We may smile. But even today surveyors make mistakes. Surveying is rarely easy, and it was even more difficult in antiquity. The wonder is that the Greeks and Romans so often got it right. It is entirely appropriate that Nonius Datus's inscription features personifications of three qualities required in a good surveyor, with the name of each below in large letters: *Patientia, Virtus, Spes*—Patience, Professionalism, Hope.

# SIX

## Urbs Roma *to Orbis Romanus: Roman Mapping on the Grand Scale*

**Richard J. A. Talbert**

From the perspectives of geography, cartography and much else, the city of Rome was a stimulating place to be during the last two centuries BCE. This turbulent period saw extraordinary expansion of Roman power far beyond the Italian peninsula in all directions. One result was that a conceptual and cultural awakening occurred, a transformation of Romans' worldview. It would be wrong to assume that previously they had been a people uninterested in organizing and recording their surroundings. On the contrary, their practice of surveying to divide up the cultivable land of their territory—explained in the previous chapter—was already long established (fig. 6.1). For defeated communities whose territory was appropriated by Rome, one of the most painful and lasting consequences of their loss must have been the manner in which Roman surveyors proceeded to alter radically, and forever, the very appearance of a once-familiar landscape. Moreover, its new Roman aspect was symbolically encapsulated in a map on stone or bronze set up in the heart of the community for all to see—for Romans a proud affirmation of conquest and ownership, to the dispossessed a bitter testament to their permanent loss (figs. 6.2a and 6.2b). In time, Roman surveyors extended their coverage to cities, making very detailed maps that in some cases were engraved on marble and presumably put on display; 1:240 came to be a standard scale for such surveys. Various fragments survive to convey a sense of how impressive these painstaking city maps must have been—recording owners' names, for instance, and the length of a property's street frontage, not to mention individual walls, columns, steps, staircases, doorways, and other such features (figs. 6.3a and 6.3b).

Despite the fundamental importance of Roman land surveying, its spatial range came to seem relatively modest from the second century BCE onward, when for the first time the Romans found themselves embroiled in struggles spanning the entire Mediterranean and even well beyond (figs. 6.4a and 6.4b).[1] An enlarged spatial vision was now essential. Its public representation no doubt stemmed in part from the established familiarity with land survey maps, in part also from the practice which victorious generals had adopted of commissioning huge pictures of their battles and sieges that were then displayed, among other means, by being carried in triumphal processions through Rome.[2] A third and growing source of inspiration and understanding is likely to have been the Greek tradition of geography and cartography, which—as chapter 3 demonstrated—had been greatly advanced by Eratosthenes at Alexandria during the third century. We hear that as early as 174 a former consul (chief magistrate and general) set up a tablet in the Temple of Mater Matuta in Rome commemorating his subjugation of the island of Sardinia. Accompanying it, we are told, was a *forma*—literally a "shape" or "outline"—of the island, on which battle scenes were painted.[3] It is conceivable that a map is meant here, although there can be no certainty, because the Latin language in fact never develops a term to signify "map" unequivocally. So the

unspecific *forma* in this account could equally well signify a three-dimensional image, such as a statue personifying the island. But *forma* is also often the noun used for a survey map, and some sort of map is perhaps the more likely meaning for it in the context here. It was a large map of the island, we may imagine, although the character of its appearance is beyond recovery, and there is also no knowing whether it was painted directly onto a wall, or drawn on a freestanding panel, say, or on some other surface.

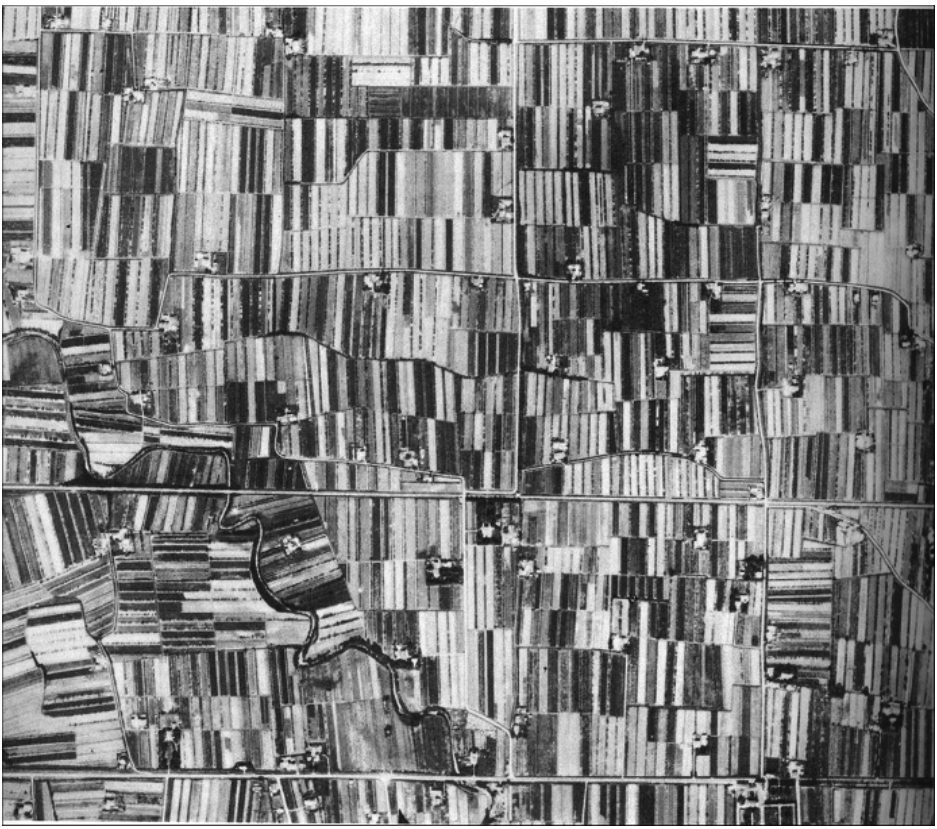


FIGURE 6.1 The pattern of Roman centuriation (probably second century BCE) still preserved in the fields of the Po valley plain near Forum Cornelii (modern Imola, Italy), seen from the air. Reproduced with permission from the British School at Rome.

FIGURE 6.2a Marble panel from an official plan recording the centuriated subdivisions of part of the territory of Arausio (modern Orange, France). This plan was made around 100 CE at a scale of approximately 1:6,000.

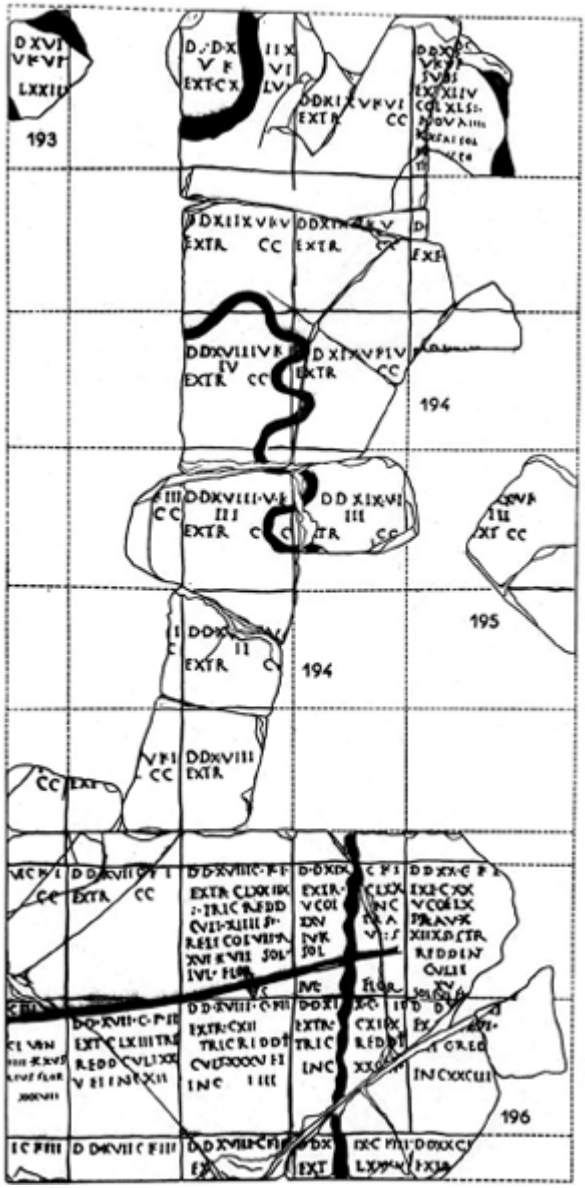



FIGURE 6.2b Drawing of as much of the same plan as can be reconstructed. Reproduced from A. Piganiol, *Les documents cadastraux de la colonie romaine d'Orange*, coll. Suppl. Gallia, XVI (Paris: Editions du CNRS, 1962), pl. XXI.

FIGURE 6.3a City plan fragment found in the Via della Polveriera, Rome. Note the figures recording a length at top right above the letter *P*.

FIGURE 6.3b City plan fragment found in the Via Anicia, Rome. Figures recording lengths, owners' names, and representation of walls by polygons are among the many features visible here. Reproduced with permission from Sovraintendenza ai Beni Culturali, Direzione Musei, Roma, Italy.

A book completed in the 30s BCE,[4] which records a discussion imagined to have occurred twenty years or so earlier, opens with the speakers gathered at the Temple of Tellus, or Earth, in Rome, all looking at *picta Italia* on a wall there. Again, "Italy painted" could be a personification or an allegorical image. But references to geography in the discussion which unfolds support the likelihood that here, too, a large map of some kind is meant, even though no further clue to the nature of the object is offered.

A distinctly more ambitious work was commissioned by Agrippa, a close associate of Rome's first "emperor" Augustus, and was only completed after Agrippa's death in 12 BCE. It is described as *orbis terrarum urbi spectandus*—"the lands of the globe for the city to look at"—and was to be seen in a portico in Rome that is now lost without a trace.[5]

For certain, there was text associated with this work, and some scholars have even argued that the work was exclusively text, like Augustus's record of his own achievements, his *Res Gestae*, a document prominently inscribed in Rome and elsewhere across the empire after his death.[6] But the choice of *spectandus*—"to look at"—in describing Agrippa's work implies something more visual than simply a text to read, and once again a large map seems the most persuasive inference, even if the nature of its appearance has to remain matter for speculation.

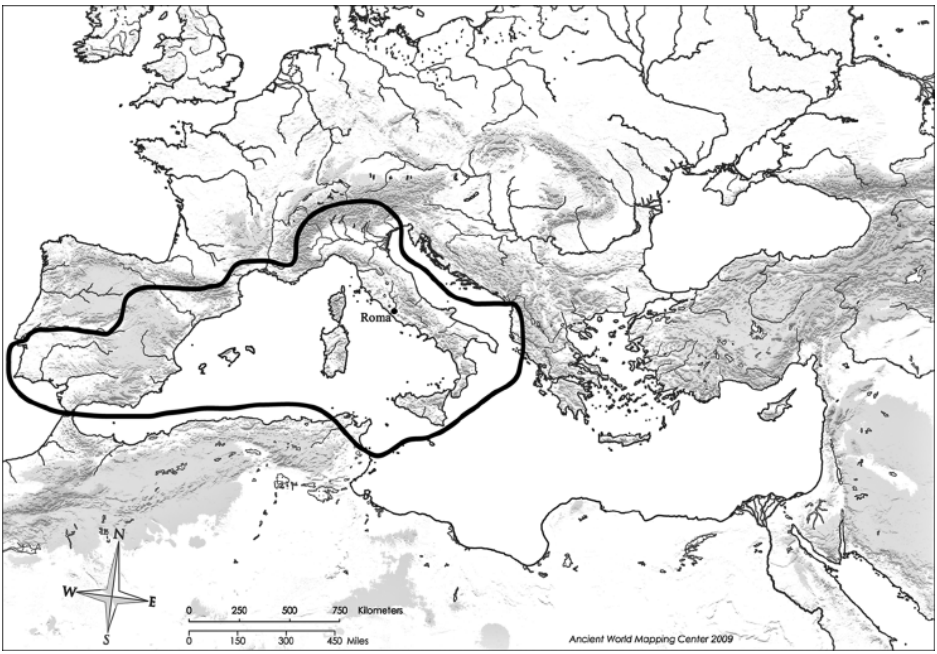



FIGURE 6.4a The range of Roman control around 200 BCE.

In particular, there is no knowing just how extensive Agrippa's map made the *orbis terrarum*, another term that Latin usage leaves imprecise. It can signify literally the entire globe, often thought to be divided horizontally by climate into zones (according to the Greek theory explained in chap. 3 and fig. 3.5): freezing Arctic and Antarctic at top and bottom; torrid equatorial zone in the center; and two habitable zones sandwiched between unbearable cold and heat, the *oikoumene* in the north, and the corresponding *antichthon*, or *antipodes*, in the south, which equatorial heat renders unreachable from the *oikoumene*. Naturally, the latter zone is the world of the Greeks and Romans, and as early as the second century BCE some admiring Greeks began hailing Rome as *the* world power, ruler of the world, or *orbis terrarum*, in the more restricted sense of "the part of the world known to us."[7] At that period it would hardly have been feasible for Romans to convey such a grandiose claim cartographically except in the sketchiest way. But this hazy vision sharpened during the first century as a result of the extensive conquests by Pompey in the east, Caesar in the west, and above all Augustus himself (figs. 6.5a and 6.5b). His generals completed the process of bringing the entire Mediterranean under Roman control, as well as pressing on further to the Danube and Euphrates, and even into Germany, Arabia, and Ethiopia. By no means all these bold forays proved successful. Moreover, the sway that Augustus also claimed to hold through diplomacy over Britain, Persia, and India had minimal substance to it at best.[8]

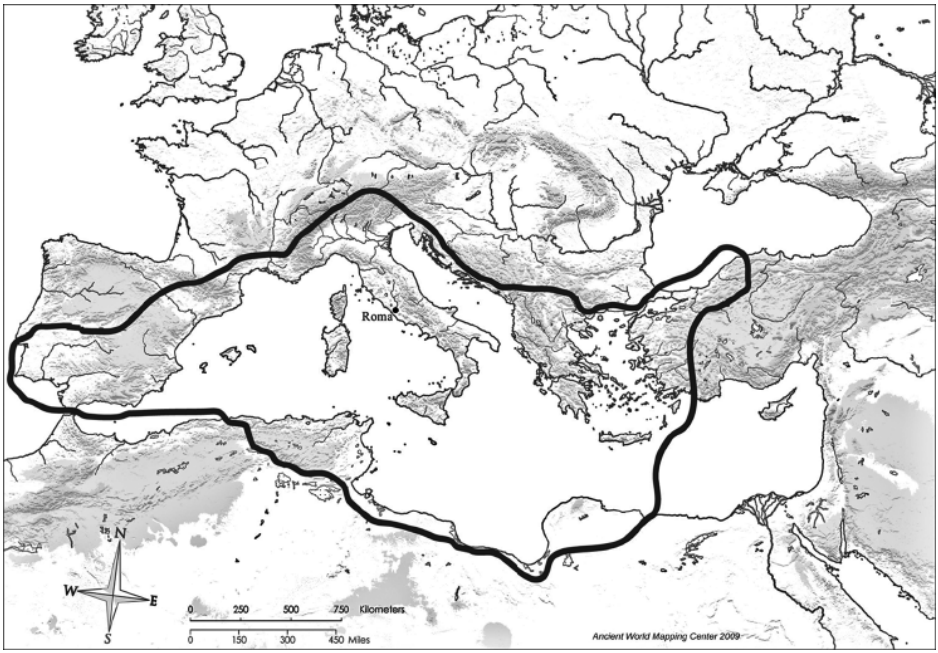



FIGURE 6.4b The range of Roman control around 70 BCE. Maps made by the Ancient World Mapping Center, University of North Carolina, Chapel Hill, and reproduced with permission.

Even so, for purposes of image making Augustus's exaggerations were immaterial. By now a more comprehensive vision of Rome's empire had been achieved, and it was this that Agrippa's large world map proudly presented not in mere fuzzy outline but rather with close attention to accuracy. Although its scope and its appearance both remain irrecoverable, I think we may confidently assert that Agrippa's commission introduced a novel and highly influential level of map. There had been no previous cartographic power statement on this kind of scale by any state in the ancient Mediterranean or Near East. This type now came to be disseminated not only by Romans themselves, but also subsequently by their successors and emulators from Charlemagne, through the Middle Ages and Renaissance, up to Mussolini, who commissioned a series of five maps outlining the spread of the ancient and modern Roman empires to 1936. The first four of these maps are still to be seen on display along the Via dell' Impero (today Via dei Fori Imperiali), which Mussolini began to ram through from the Piazza Venezia in central Rome to the Mediterranean at Ostia; the fifth map was removed from there in 1945.[9]

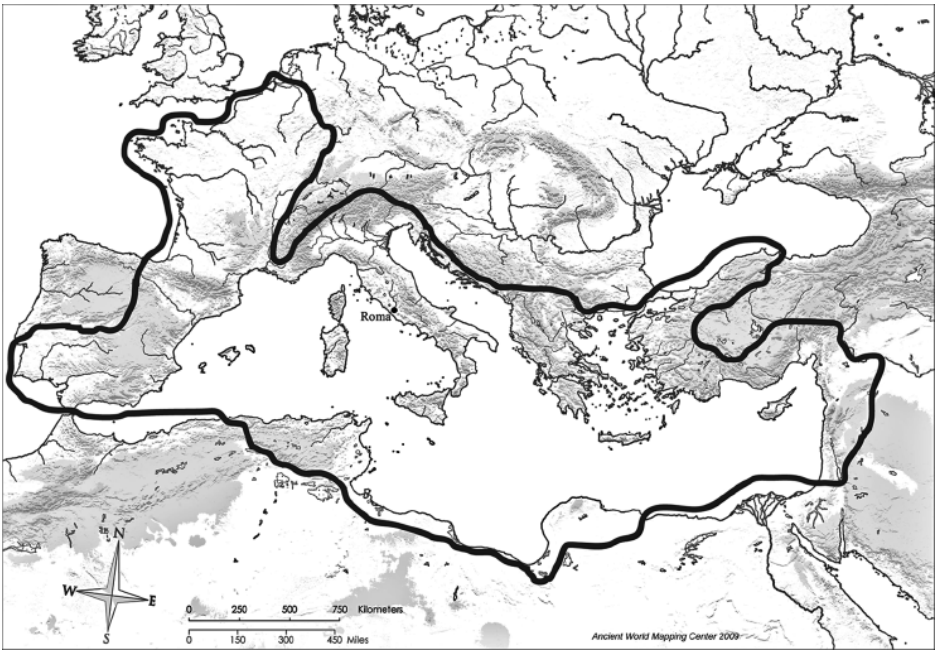



FIGURE 6.5a The range of Roman control around 50 BCE.

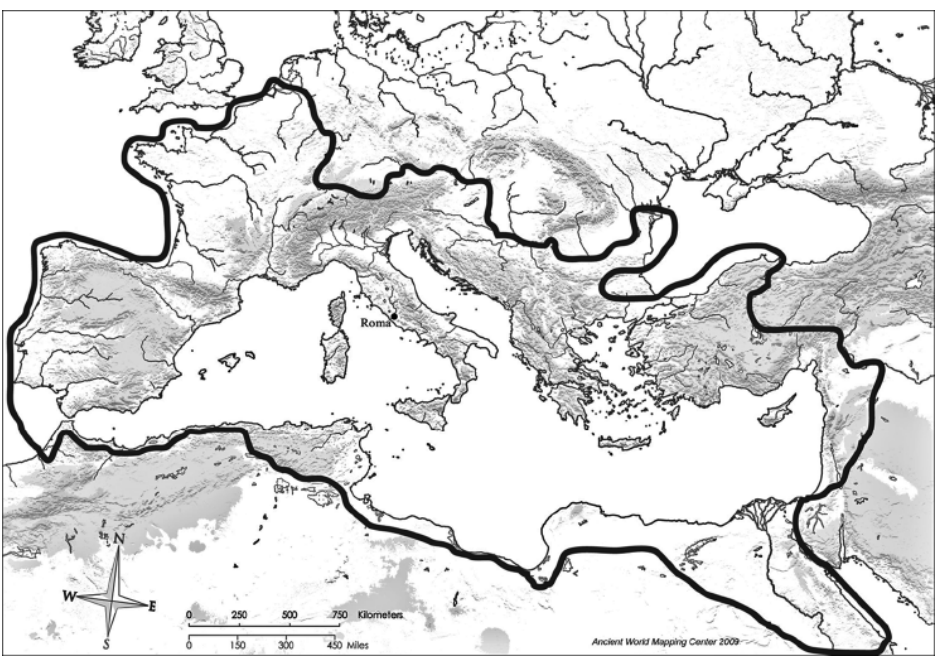



FIGURE 6.5b The range of Roman control around 14 CE. Maps made by the Ancient World Mapping Center, University of North Carolina, Chapel Hill, and reproduced with permission.

The little recorded about ambitious maps produced after Agrippa's time has almost nothing to say about their appearance. For example, a high-ranking lady's presentation of a tapestry world map to an unidentified Roman emperor (no later than around the

mid-first century CE) is commemorated in a Greek epigram, but the actual nature of the map does not concern the writer. At the same period, I believe that the scholar-emperor Claudius employed a map which somehow encompassed Britain to Italy as a visual aid for a speech he made to the senate in Rome; but this can only be an inference.[10] There does at least survive a description of one world map, which perhaps had regional maps associated with it too. To be sure, this description dates to considerably later—to the period of the tetrarchy, or four coemperors, at the end of the third century—and it occurs in an unashamedly rhetorical speech. Even so, its testimony is unique and precious. The map in question is termed an *orbis depictus*, "a picture of the world," a display piece and instructional tool installed in a rhetorical school at Augustodunum in Gaul (modern Autun in France). This school had suffered damage during the turmoil of the previous half century, and the speaker Eumenius, the highly paid new head, seeks a provincial governor's permission to rebuild it at his own expense. One feature that is evidently already in place in the school, and has even been seen by the governor, is this map. Eumenius devotes the climax of his speech to explaining its value:

In the porticoes let the young men see and examine daily every land and all the seas and whatever cities, peoples, nations, our most invincible rulers either restore by affection or conquer by valor or restrain by fear. Since for the purpose of instructing the youth, to have them learn more clearly with their eyes what they comprehend less readily by their ears, there are pictured in that spot—as I believe you have seen yourself—the sites of all locations with their names, their extent, and the distance between them, the sources and mouths of rivers everywhere, likewise the curves of the coastline's indentations, and the Ocean, both where its circuit girds the earth and where its pressure breaks into it.

There let the finest accomplishments of the bravest emperors be recalled through different representations of regions, while the twin rivers of Persia and the thirsty fields of Libya and the convex bends of the Rhine and the fragmented mouths of the Nile are seen again as eager messengers constantly arrive. Meanwhile the minds of those who gaze upon each of these places will imagine Egypt, its madness set aside, peacefully subject to your clemency, Diocletian Augustus, or you, unconquered Maximian, hurling lightning upon the smitten hordes of the Moors, or beneath your right hand, Constantius, Batavia and Britannia raising up their grimy heads from woods and waves, or you, Maximian Caesar [Galerius], trampling upon Persian bows and quivers. For now, now at last it is a delight to examine a picture of the world, since we see nothing in it which is not ours.[11]

In other words, here is a map, or maps, with ambitious scope and a mass of accurate physical and cultural detail inviting appreciation on more than one level. The map can instruct the school's pupils in geography. It can also inspire them to celebrate the way in which the four coemperors in Diocletian's new tetrarchy have suppressed risings by dissident populations in some parts of the empire, and expelled foreign occupiers or invaders (Persians especially) from other parts. In consequence, now at last Rome's longstanding claim to control the entire world can be reasserted with confidence, and Romans will no longer be distressed when they study this map.

## The Marble Plan of Rome (Forma Urbis Romae)

Speculation about the appearance of lost large Roman maps can yield few satisfying results. Ideally, the opportunity to examine surviving examples is wanted, and by good fortune two present themselves, each seemingly very different. That said, each does

come with distinct flaws and may prove to be something of a special case rather than typical.

The first survival is fragments of a giant plan of the city of Rome measuring nearly 18 m wide by 12 m high and dating to about 200 CE. This plan was carved onto a set of 150 marble slabs clamped to an end wall of a great chamber in the Temple of Peace complex in the heart of Rome. Remarkably, the wall itself with many of the clamp-holes still survives; today it forms the very visible outside back wall of the church of Sts. Cosmas and Damian on the edge of the forum along the Via dei Fori Imperiali (fig. 6.6). The marble slabs have fared less well. A great hole was punched into the wall sometime early in the medieval period, largely destroying beyond recovery the part of the plan where the forum was represented. Even so, about 1,200 fragments have been recovered to date, constituting perhaps 12% of the entire plan; today some fragments are known only as drawings made of pieces recovered but since lost. As is only to be expected, by no means all the fragments fit together; many are tiny and remain adrift. But plenty have been matched up, and this challenging quest has been advanced most recently by an outstanding Web-based project at Stanford University, which offers a 3-D scanned image of each fragment with ample commentary.[12]

At first glance, this marble plan of Rome might seem to be just an example of the surveyors' city maps mentioned at the beginning of the chapter. It adopts their standard scale of about 1:240 and covers about 13.5 sq km. Centered upon the Capitoline Hill, and oriented approximately southeast (fig. 6.7),[13] it too shows every ground floor room in the city as well as individual columns, steps, staircases, doorways, and more (figs. 6.8 and 6.9). On closer inspection, however, the marble plan of Rome does not quite match the surveyors' city maps. In particular, it omits much important data to be found on those maps: owners' names and distance figures, for instance, are both missing. At the same time the representation of most walls is by single lines rather than by polygons. No doubt the missing data and fuller linework were already available in maps drawn on more pliable material like papyrus (the ancient equivalent of paper); but the designers of this marble plan of Rome evidently took a deliberate decision to omit such detail. Why should they do that, when the effect would be to reduce the usefulness of their plan? The answer must lie with its presentation, on a wall, with even the bottom of the plan 3 to 4 m up from the floor, and the top a further 12 m up. In other words, it was understood from the outset that a plan installed thus could never be "useful" in any practical way. To see any part of it at all, viewers needed to stand several meters away at least, and to see its entirety they had to step far back into the chamber, which fortunately for the purpose was about 24 m long (fig. 6.10).

FIGURE 6.6 The wall on which the marble plan of Rome was originally mounted. Note the holes for the clamps which kept the slabs in place. Photograph by Elizabeth Robinson, reproduced with permission.

There was no viewing point, however, from which the detail could be appreciated; no one could ever gain more than a general impression of it. The designers duly recognized this limitation and so reduced most walls to single lines in order to prevent the plan from gaining a very cluttered appearance; that decision also meant a huge reduction in the amount of engraving to be done. At the same time the designers strove to help viewers orient themselves by coloring many temples red (reckoning that these were likely to be familiar landmarks). Only structures such as major public buildings, aqueducts, and roads were named; and some of the buildings designed for entertainment were represented in bird's-eye view rather than showing the ground floor layout in the regular way (fig. 6.11, *a*). Taken together, these various aids to comprehension suggest a conscious effort to render the map accessible and meaningful to the maximum number of viewers, including ones who were barely literate, let alone accustomed to reading maps.

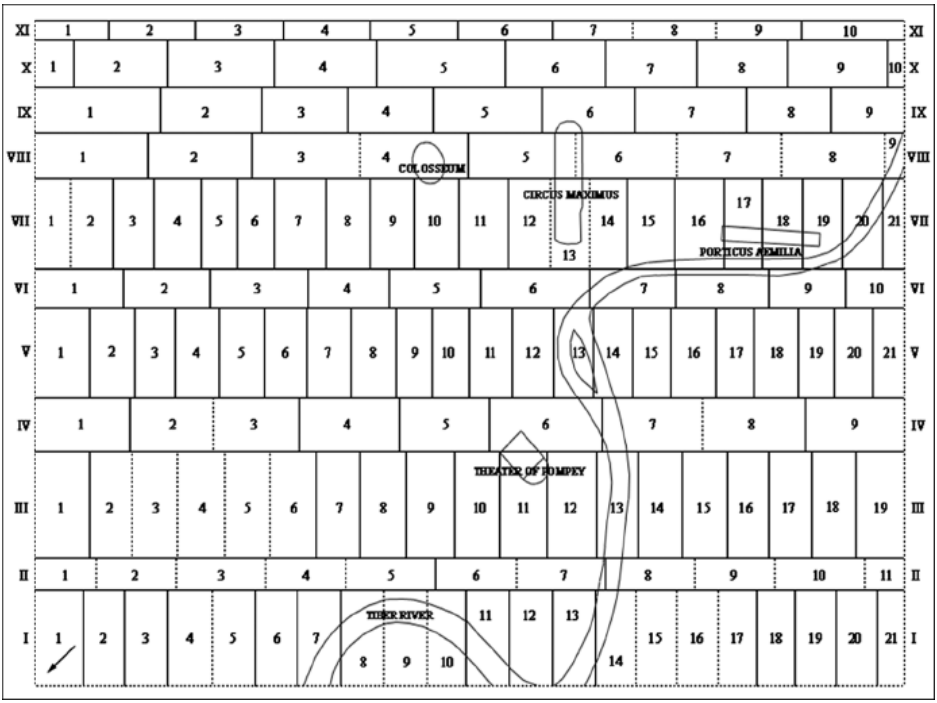



FIGURE 6.7 Reconstruction of the layout of the slabs forming the marble plan. Rome's forum area would have appeared more or less at the center. Courtesy of the Digital Forma Urbis Romae Project, Stanford University.

In such conditions, therefore, we may fairly ask, why should the designers and engravers of the plan take such pains over the detail that was included, when they already knew that no viewer would ever be able to appreciate it properly? Before attempting an answer, it is worth observing that our modern ability to subject the fragments to close scrutiny enables us to detect that the work was not in fact always as painstaking as it might have been. The proportions of rooms or buildings may appear squashed or stretched, for example (fig. 6.11, *b*). Such distortion is understandable enough, however, if (as seems most likely) it derives from the delicate challenge of accurately matching up sets of surveyors' sheets that each covered a very confined area. More puzzling are several instances where archaeology has established that the form in which a building appears on the plan is very outdated. A clear case is the Portico of Octavia, which appears in its original early-first-century CE form, not at all as it would have looked by the end of the second century (fig. 6.11, *c*). Elsewhere on the plan, by contrast, the effort is made to include the Septizodium, a new monument commissioned by the emperor Septimius Severus, the same ruler who must have commissioned the plan itself.

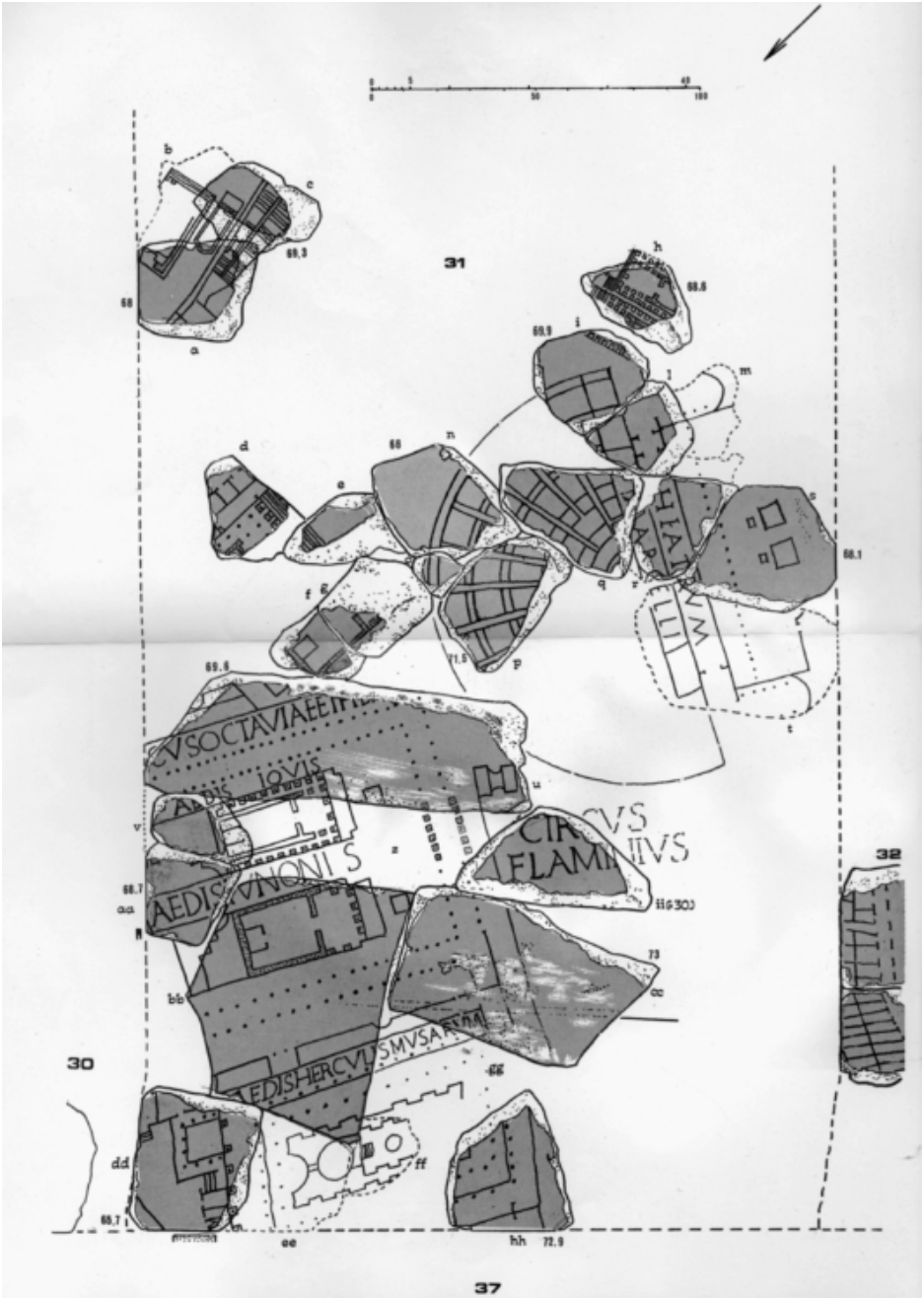



FIGURE 6.8 Reassembly of marble plan fragments. Reproduced from E. Rodriguez-Almeida, *Forma Urbis Marmorea: Aggiornamento generale 1980* (Rome: Quasar, 1981), vol. 2, pl. XXIII, with permission of the publisher.

FIGURE 6.9 Reassembly of marble plan fragments (detail). The V-shaped symbol marks a staircase. Courtesy of the Digital Forma Urbis Romae Project, Stanford University.

I am frankly at a loss for a convincing explanation of such discrepancies. At least it is evident that the makers of the plan felt no special concern to ensure an up-to-date rendering of the city in every detail, and they were shrewd enough to recognize that such perfectionism was uncalled for. To them, the greatest importance of the detail was not so that viewers could examine it minutely, but rather for the overall impression that it created. The sheer capacity to record, organize, engrave, and present it all served as a magnificent tribute to Roman resources, coordination, skill, and control. From the perspective of a viewer standing in the body of the chamber, the countless components of the detail—individually boring and unmemorable—combine to offer an awesome overall vision of the man-made underpinning to this capital of a world empire, by far the largest city in the known world. Such a sense of wonder, variously mixed with pride, or hatred, or fear and other emotions, surely has to be the reaction that the plan was

intended to evoke in viewers as they—already themselves present in the heart of Rome—gazed at this gigantic rendering of the entire city looming over them. It may well be that to display Rome or any other city as the marble plan does here constitutes a novel experiment in the tradition of Romans' large public maps. If so, the creativity of its imaginative, but anonymous, designers merits our admiration all the more.

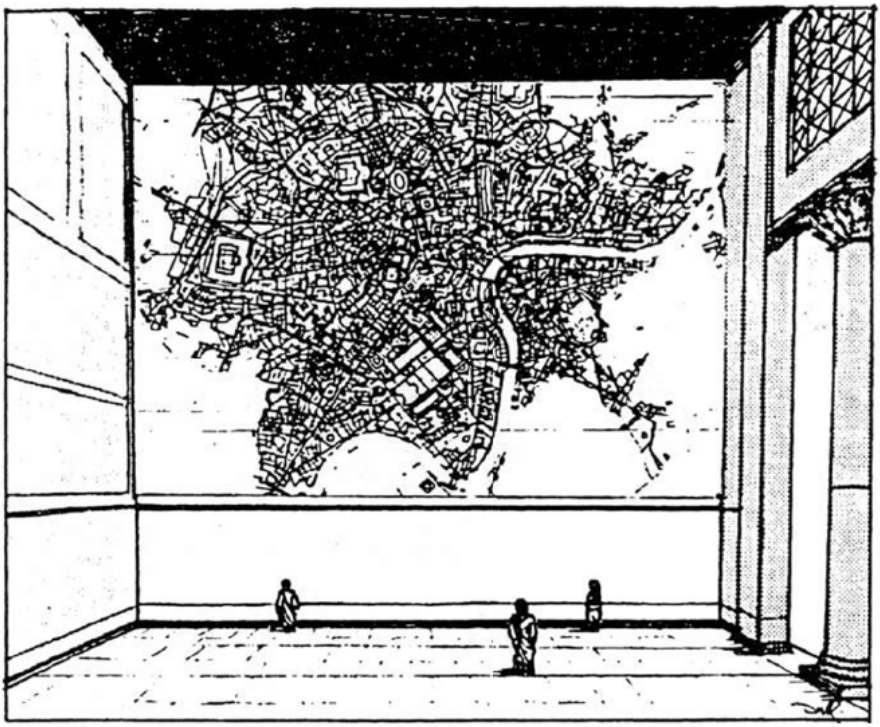


FIGURE 6.10 The marble plan from its viewers' perspective (reconstruction). Courtesy of David West Reynolds/Phaeton Group.

## The Peutinger Map

### CHARACTER, PURPOSE, CONTEXT

The second large Roman map that it is possible for us to examine remains likewise anonymous. Unlike the marble plan, however, it is shorn of a context, and it only survives in the form of a single medieval copy, which is missing the original map's left-hand end. There is no testimony to where the copy was made or when, let alone the original map. Such depth of ignorance could serve to discourage further enquiry, but there is no cause to be so despairing. The map's predicament hardly differs from that of countless ancient manuscripts and other material objects which come down to us only as isolated, damaged survivals. It is necessary to seek out clues, hypothesize, and reconstruct; the quest is a challenge with risks, but it can prove instructive especially if a probing range of questions is raised.[14]

*a*

*b*

*c*

FIGURE 6.11 Marble plan: *a*, Bird's-eye view perspective (Theater of Marcellus). *b*, Rooms or buildings squashed or squeezed. *c*, Portico of Octavia. Courtesy of the Digital Forma Urbis Romae Project, Stanford University.

Even incomplete, the map as known to us is a colorful, striking object, especially because of its unusual shape—670 cm long or wide, but only about 13 cm tall. The copy

in fact comprises eleven pieces of parchment, each about 60 cm long, that were gummed one to the next to make up the 670-cm-long strip or roll (fig. 6.12 and plate 6). The copying probably occurred around 1200, possibly somewhere in the general area of Germany. At some stage during the three centuries that followed, an institution or individual in possession of the map showed sufficient interest to nail it up for display; several of the nail holes remain visible. Eventually, around 1500, the map was somehow "discovered" at an undisclosed location and removed by the notorious manuscript hunter Konrad Celtis. Soon afterward it came into the possession of the major German collector Konrad Peutinger in Augsburg; hence, it is usually referred to by his name the Peutinger map (latinized as Tabula Peutingeriana). Since 1738 it has been a prized possession of Austria's national library in Vienna. In 1863 the eleven parchments forming the roll were separated for better conservation.

The map's design, however, is a single cohesive one which spans all eleven parchments (fig. 6.13). It comprises the world known to the Romans, oriented North, ending with India and Sri Lanka at the right, and no doubt beginning from Britain and the Atlantic coast of mainland Europe and Africa at the lost left-hand end (at the surviving far left, southeast England and southwest France are to be seen). To compress such an extended north-south expanse into a frame no more than 13 cm tall presents a formidable challenge by any standard. In addition, the further, carto-graphically distorting, decision was taken that the map's central point must be the city of Rome. In other words, there is only the same amount of space for covering the vast arc from Rome to Taprobane (modern Sri Lanka) as there is for covering the notably shorter span from the Atlantic coast of the Iberian peninsula to Rome.

Draconian selectivity is called for, therefore, and it is duly exercised. A single scale for the map (as might be expected today) is unattainable. Rather, the scales—if we can even call them that—vary across it region by region, with Italy (Rome's heartland) rendered large relative to all others, while Persia and India by contrast both suffer especially severe compression. A related choice is to privilege land over sea by contracting substantial bodies of open water. The Mediterranean Sea in particular becomes little more than a narrow channel, and its islands, peninsulas, and shorelines are manipulated to fit there. Altogether this is shockingly audacious, creative cartography, manifesting even a touch of whimsy to amuse sophisticated viewers intrigued by its more bizarre distortions.

In all likelihood the basis of the Peutinger map is one or more maps that strove for geographic accuracy in the Alexandrian tradition as instituted by Eratosthenes and developed by Marinus, Ptolemy, and others. It is most obviously from such maps too that the designer is able to mark principal settlements, likewise rivers, islands, provinces and regions, peoples, and seas. Unmistakably missing, by contrast, despite the map's Roman character, are all military installations—legionary camps, garrisons, fortified frontier lines—and indeed all boundary lines, even the outer limits of the Roman empire.

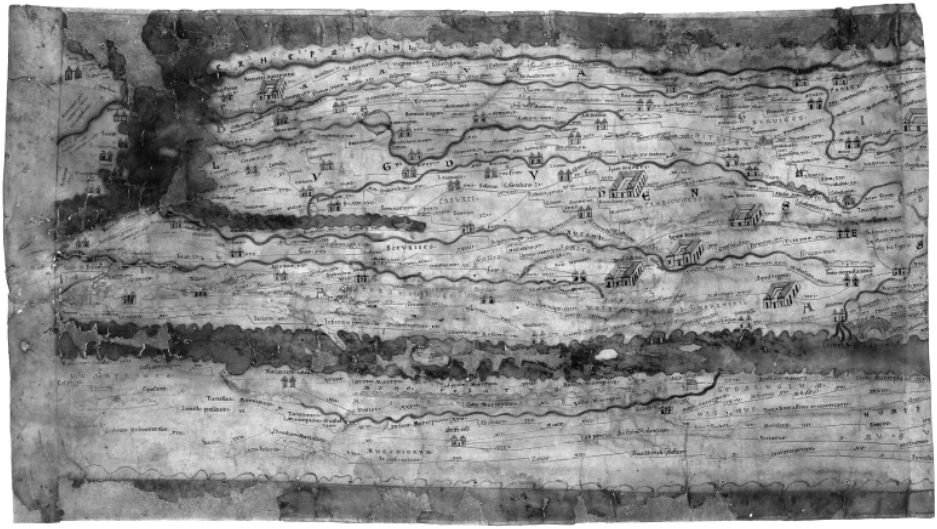


FIGURE 6.12 Peutinger map: furthest left of the eleven surviving parchments. Southeastern England appears top left. Southwestern France appears immediately below it, and then further below (extending across the entire segment), the narrow channel for the Mediterranean Sea. ÖNB/Wien, Cod. 324, segm. 1. Reproduced with permission.

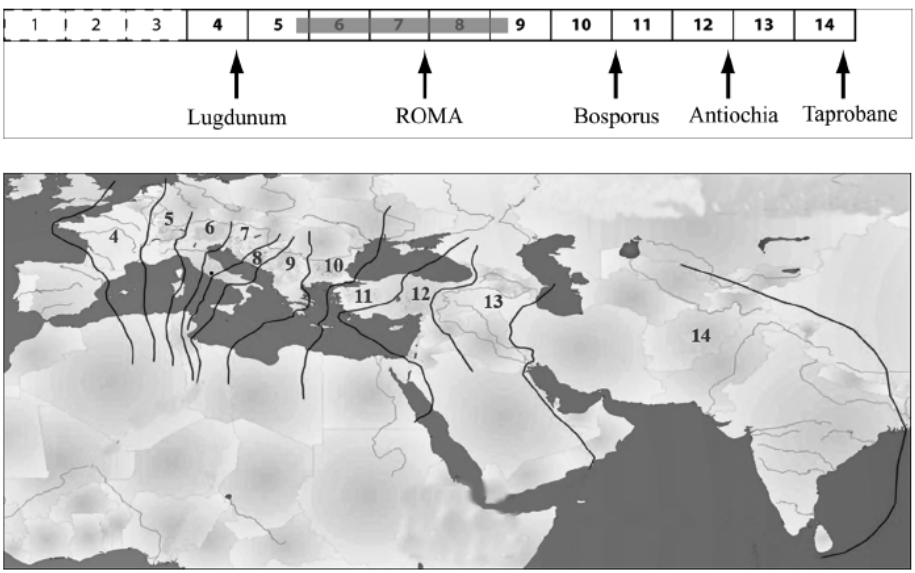



FIGURE 6.13 *Top*, The spread of the Peutinger map's eleven surviving parchments (numbered 4–14), with three at the left-hand end restored; shading denotes the extent of Italy. *Bottom*, The approximate coverage of each surviving parchment is plotted on a modern outline map. Diagram by the author; map courtesy of Christos Nüssli, Euratlas.

A man-made feature that stands out across the entire map is red linework for land routes that fan out from Rome everywhere across the empire and even onward into Persia and India. This is the feature of the map that has repeatedly captured scholars' attention (fig. 6.14 and plate 7), leading in consequence to relative neglect of other

characteristics. The scholarly consensus has always been that the map was designed to serve as a practical tool for reference, an ancient AAA Triptik that travelers could roll up and conveniently carry with them on journeys. This is the view repeated by Oliver Thomson in his introduction to the 1961 revision of *Everyman's Classical Atlas*: "As a map, this ribbon is absurd, but its aim is only to give roads with their stations."[15] The claim has even been advanced that the route network itself forms the basis of the map—making it a forerunner, so to speak, of the famous London Tube diagram developed by Harry Beck in the 1930s—and that all the map's other physical and cultural components were only added subsequently as mere decorative embellishment.[16]

In my view these ideas are long overdue for reappraisal. Anyone with experience of the actual steps required in the design and production of a map will surely find it impossible to credit that the route network can form the basis of the Peutinger map, rather than its shorelines, principal rivers, and principal mountain ranges; these basic elements of the physical landscape would have to be laid out first. This map is not just a decorated diagram, and its designer was plainly much preoccupied with features other than the route network and unrelated to it (islands, for example), conspicuous though it is. Moreover, attempts to use the network as seen here for actual journeys soon expose multiple limitations above and beyond the fundamental distortion created by the extreme shape of the map and Rome's placement at its center. For example, stopping points that ought to be marked turn out to be omitted; only a roundabout route is liable to be shown, while a direct one for the same journey is ignored; some routes cannot date to later than the first century CE, while others can be no earlier than the second century CE; no indication is given that certain routes drawn on land can in fact only be traversed by ship; and so on.[17] Altogether, therefore, the strong impression emerges that the designer was not seriously concerned to make the route network a practical guide for travelers. Rather, I suggest, he wanted to feature the network for much the same reasons that the designer of the marble plan wanted to include every wall and column and step in Rome—for the cumulative effect of the detail, not for the individual worth of each routine component. The route network was to serve as a distinctive "filler" for the map.

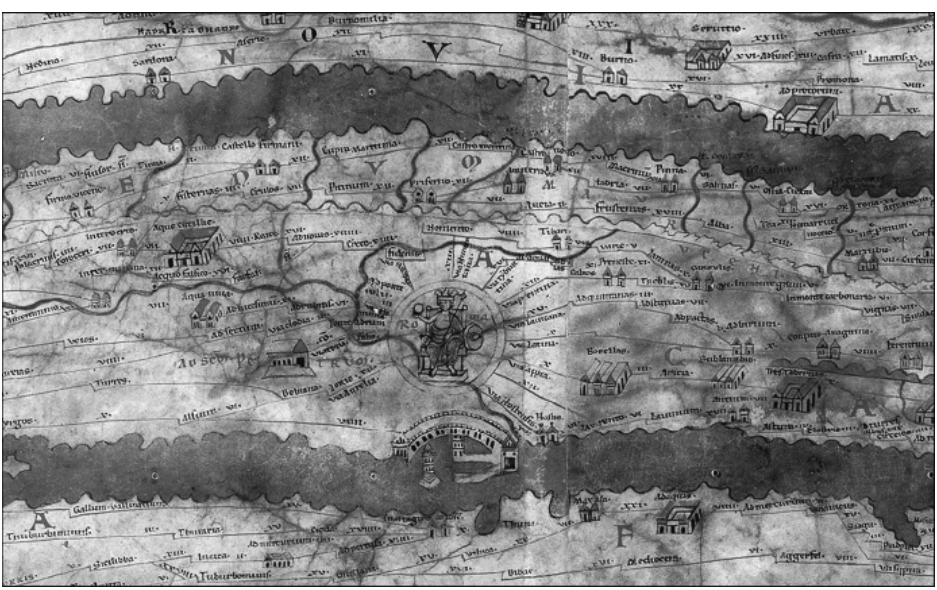


FIGURE 6.14 The city of Rome and routes fanning out from it on the Peutinger map. ÖNB/Wien, Cod. 324, segm. 4 + 5. Reproduced with permission.

More generally, if the map's intended function was not to serve as a portable guide for travelers, what purpose did its designer have in mind? Our best clues in my opinion are once again the map's extreme shape and the further distortion caused by the placement of Rome at its center; these special characteristics need to be pondered, along with the choice of features for inclusion and exclusion. The resulting combination is most convincingly interpreted, I think, as a cartographic celebration of Rome and its empire, indeed, its sway over the entire known world. Moreover, this is a seamlessly unified sway (boundary lines are absent), urbanized and thus civilized, offering ease of movement by land routes in all directions, peaceful, inclusive. To comprehend the map fully and to grasp the significance of Rome's central placement, viewers must stand well back, just as they needed to in the case of the marble plan.

To be sure, the squat height of the map still needs to be accounted for. Such squatness would seem unnecessarily restrictive if the map was a self-contained object, but not perhaps if it originally constituted only part of a larger artwork that is otherwise now lost. Various possibilities can be imagined. I admit to being most attracted by one in which the map is designed to represent the northern habitable zone—the *oikoumene*—of a globe image divided horizontally by zones according to the Greek scheme outlined above and in chapter 3. In such an instance, depending on the height imagined for each zone (including possible double height for the equatorial zone), the full image could easily attain 2 m.

Who would commission such a tall, wide image, and where would it be placed? The commission surely has to have come from an emperor or the close associate of one; the map in particular is too strong an affirmation of power for anyone outside that circle to risk ordering its production independently. In addition, its sheer size makes it a piece for display rather than an item suitable for private space. Apart from a few Christian notations manifestly added later by well-meaning copyists, there is no hint of original Christian content or a Christian outlook. The map is likely to date to the period before Constantine, therefore, to Diocletian's tetrarchy at the latest, around 300 CE. It could not have been produced before the early second century CE, however, because it includes routes in Dacia, which only became Roman territory in that period.

While any date from the early second century to the late third seems possible in principle for the map's production, there can be no question that such an initiative would fit the tetrarchs' agenda and image uniquely well. As Eumenius recognized in his praise of the world map at Augustodunum quoted above, the tetrarchs were eager to celebrate how they had restored and reunited the empire, how it was now peaceful and stable again at last, and how its four joint rulers were in concord with one another. They took pride, too, in their tireless travels undertaken for the welfare of the regions assigned to them; in consequence, land routes were of the greatest importance to them. Their outlook is solemnly articulated in the climax of the immense sentence that opens their Edict on Maximum Prices, issued in 301 and known from inscriptions:

Public decency and Roman dignity and majesty desire that the fortune of our state be organized in good faith and elegantly adorned, and that it be thanked—beside the immortal gods—as we recall the wars that we have fought successfully, at a time when the world is in tranquility, placed in the lap of a most profound calm, as well as

benefiting from a peace which was toiled for with abundant sweat. Let us therefore, we who with the kind favor of the deities crushed the previous seething ravages of barbarian peoples by destroying those very nations, protect the peace established for eternity with the appropriate defences of justice.[18]

The tetrarchs deliberately adopted a loftier, more authoritarian style of rule than that of previous emperors. They sat on thrones and received homage amid elaborate, colorful ceremonial. Where better, then, to place a globe image of the type I envisage, oriented north, than in a tetrarch's *aula* or throne room, a space developed from the traditional basilica, but now with an apse at one end of the hall within which to set a throne? Moreover, if such a globe image occupied the rounded end of the apse, behind the throne, where would the city of Rome appear but at the center of the *oikoumene*, directly above the head of the tetrarch sitting upon his throne (fig. 6.15)? Viewers' attention during ceremonies could in any case hardly avoid focusing on the *oikoumene* part of the image, because the standing figures of the tetrarch's close associates flanking the throne would hide much of the lower half; in addition, everywhere outside the *oikoumene* the environment would appear bleak and insecure, lacking cities and routes in particular.

If there were protruding spur walls on either side of the apse (as seems to have been common),[19] then most viewers in the body of the *aula* gazing forward at the globe image would have been unable see the far ends of the *oikoumene* on the map. As a result, the traditional notion that Roman sway was "empire without end" (*imperium sine fine*) would only be reinforced: for these viewers, the map, and the empire, just continued on out of sight to west and east. None of the empire's provinces would lie beyond their field of vision. By contrast, India to the far right might be more or less hidden, but it was never under Roman rule, of course, and since to most Romans it merely symbolized the distant and exotic, the map's token representation of it would be quite sufficient.

Rhetoric, it need hardly be added, claimed control of the world for the tetrarchs, and even of the cosmos. On the arch of the tetrarch Galerius at Thessalonica, two of the emperors sit side by side flanked by the other two standing (fig. 6.16). A pair of busts below the seated pair have been plausibly identified as Sky and Earth, while at either side of the same scene appear reclining personifications of Earth and Sea.[20] In their Edict on Maximum Prices, already quoted above, the tetrarchs proclaim that it applies "not [just] to individual cities and peoples and provinces, but to the entire world [*universus orbis*]."[21] Most remarkably, in an unprecedented find dating to 2005, a set of imperial emblems was recovered during an official excavation on the northeast slope of Rome's Palatine Hill (not far from the Colosseum).[22] These *signa imperii* emerged from a sturdy poplar-wood box that had been buried with care. In it were wrapped—in silk and linen—three bronze pikes, a scepter, five javelins, and four spheres or globes, three of glass and one of blue chalcedony (quartz). These latter served as orbs that a Roman ruler mounted on a scepter or held in his hand to symbolize world domination (fig. 6.17 and plate 8). The ruler in this instance was most probably the usurper and would-be tetrarch Maxentius, who held Rome but had to defend it against an attack by his rival Constantine during the fall of 312. In the fateful battle at the Milvian Bridge Maxentius was killed, and these insignia, which had been buried for safekeeping, were never retrieved.

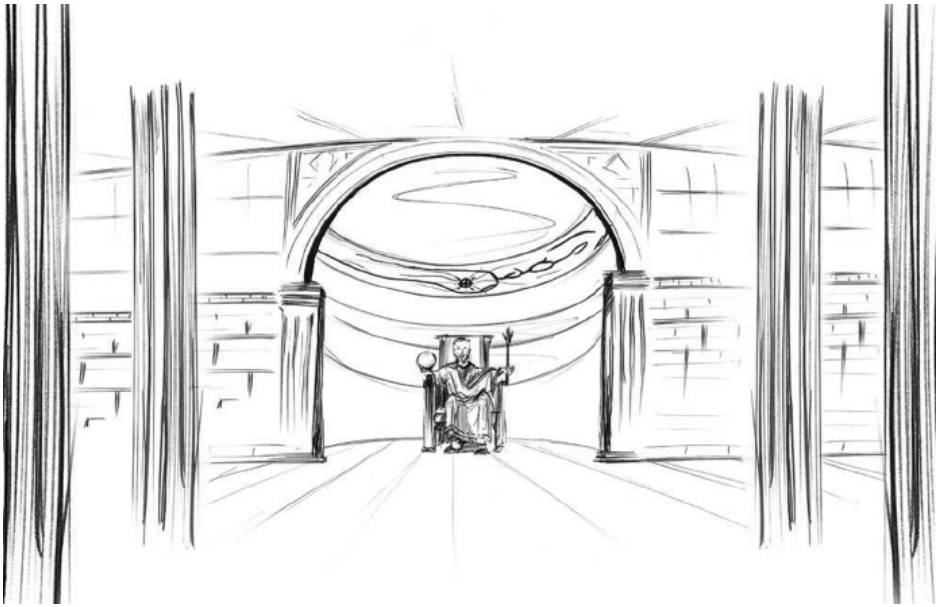


FIGURE 6.15 The Peutinger map imagined as the northern habitable zone within a globe image decorating an apse behind a Roman ruler's throne. Sketch by Daniel Talbert, reproduced with permission.

The excellent preservation of the basement level in the palace built at Split (in modern Croatia) by Diocletian for his retirement aptly illustrates the possible placement of a globe image in the apse of the hall there and the range of vision from the body of the hall (fig. 6.18).[23] Two cautionary notes should be struck in this connection, however. First, it is impossible to establish whether or not the architecture of the *aula* itself on the lost main level above was identical to what survives at basement level, although in all likelihood it was. Second, any temptation to indulge in the further speculation that the Peutinger map was designed for this specific setting should be avoided. There is no justification for it, and no need. Conceivably, the image as I envisage it may have been mounted on panels, thus allowing all of it or parts (the map especially) to be transported and reassembled in whatever settings presented themselves elsewhere. As it happens, King Henry VIII of England, another ruler who was constantly on the move, is known to have had a world map, a *mappa mundi*, that went with him on his royal progresses and formed part of "the Removing Guarderobe . . . attendaunt at the Courte uppon the kinges most Roiall personne where the same for the tyme shall happen to be," as an inventory made after his death in 1547 records.[24]

FIGURE 6.16 Arch built as the entrance to the palace of the tetrarch Galerius at his capital, Thessalonica, Greece (detail from south pier, north face). Digital image by J. Matthew Harrington, reproduced from Wikipedia Commons.

FIGURE 6.17 Imperial orbs excavated in Rome and associated with the self-proclaimed tetrarch Maxentius. Photograph by Clementina Panella, reproduced with permission.

FIGURE 6.18 Basement-level hall in Diocletian's palace, Split, Croatia, looking toward the apse. Photograph by Greg Aldrete, reproduced with permission.

**ORIGINALITY AND IMPACT**

Even if some or all these speculations fail to carry conviction, I nonetheless urge support for my concern to reconstruct a meaningful context and function for the Peutinger map. To date, the scholarship devoted to it has largely failed to appreciate its shape, orientation, layout, and choice of data as a set of deliberate, linked choices on the part of the designer. These fundamentals are not to be taken for granted as standard, or even simply ignored; rather, they are all distinctive, and as such offer the best means by which to recover the thinking that underlies the design.

The degree of originality in the Peutinger map's design is an important issue, but a hard one to resolve with confidence when our knowledge of large Greek and Roman maps remains so defective. It is at least conceivable, however, that no previous mapmaker had dared to take a frame of such extreme dimensions, and then to set the entire *orbis terrarum* within it, with a central placement for the city of Rome. All of these initiatives require the landscape to be remolded on an epic scale, a transformation that the Peutinger map's designer deftly accomplished with the intention above all of promoting and celebrating Roman power. As Alexander Jones observes in chapter 4 above, the style of cartography pursued by Ptolemy in the scientific tradition of Hellenistic Alexandria was studiously "unpolitical" by contrast; it barely acknowledged Roman rule, much less sought to celebrate it. To Ptolemy, moreover, it was vital that the world map he prescribed should *look* like part of a globe; hence arose his intense preoccupation with projection. To be sure, such cartography still offered scope for parading Roman achievements, and the map in the school at Augustodunum evidently used it thus, as no doubt had Agrippa's map in Rome much earlier. The radical shifts introduced by the designer of the Peutinger map, however, belong to a wholly different

league and could well be unprecedented. He may indeed have realized from the example of the marble plan of Rome how effectively it was possible to adapt detailed, official map materials for a quite different fresh purpose if they were fitted together, appropriately simplified and arrestingly presented; even so, the Peutinger map is altogether far more ambitious in the ways that it reflects such thinking.

It may also be unusual, if not unprecedented, for the city of Rome to occupy the center of the map. As Benet Salway explains in the following chapter, once the Romans' empire dominated the Mediterranean and beyond, this sea evidently became the central feature in their mind's eye, and the various surviving descriptions of provinces, say, or listings of legionary bases, typically proceed anticlockwise starting from some point at the fringe, not from Rome itself.

An associated feature of the map that stands out for being not merely unusual, but also in all likelihood unprecedented, is its comprehensive featuring of land routes. Testimony confirming their appearance on other Greek or Roman maps is all but nonexistent, and we can readily imagine that cartographers who strove to produce accurate maps of large regions would hesitate to introduce such complex linework. Equally, it would seem that the emperors of the first two and a half centuries CE were unconcerned to make widespread claims about their control of land routes over a vast area.[25] In practice, the maintenance of routes was divided among local communities everywhere, and they may hardly have been visualized as an integrated empire-wide "network" even by emperors. It could have been the new ideology of the tetrarchy, however, that inspired the designer of the Peutinger map to think in these terms. The tetrarchs were committed to coordinating tighter control at the local level across the empire, and mobility was vital to them and their troops. Although the routes as represented by the map are barely adequate for making or planning actual journeys, and any specifically military reference is absent, nonetheless, the range and value of the network are brilliantly conveyed. Forging horizontally and purposefully across the landscape, the routes infuse the map with a cohesion and dynamism not to be found in anything compiled from Ptolemy's coordinates. For all their dedication to accuracy, such products of the Hellenistic tradition remain static in appearance.

If fitting together the route network for incorporation in the map was indeed an original initiative, it may well have presented the designer with a more formidable challenge than he had anticipated, because for the most part the extensive data required were probably not already assembled and accessible in a convenient form. Instead, in all likelihood, they had to be first painstakingly gathered from a mass of individual, overlapping itineraries, next organized, and then plotted from scratch.[26] The result of this labor was dramatic in its effect, however: perhaps for the first time, physical and man-made features recorded by cartographers in the Alexandrian tradition were now integrated on a map with vast numbers of towns and way stations that had never been marked on any previous map except maybe a local one. Because these places lay along routes shown on the map, the lack of coordinates for them was no obstacle to their inclusion, and in any case the map's distorted shape confirmed a lack of concern to position them with geographic accuracy.

Despite the thinness of the surviving record, we can identify a twofold impact made more or less directly by the cartography of the Peutinger map through the next millennium. First, it is clear that further maps were produced incorporating the type of data from itineraries that appear to us as an innovatory component of the Peutinger map. The testimony is both textual and cartographic. Earliest is that of the *Cosmographia,* a

text compiled in Latin by an unnamed cleric claiming to be from Ravenna, probably around 700.[27] His purpose of seeking to preserve a vision of the world once known to the Romans prompts him to list, region by region, the names of settlements, rivers, islands, and peoples, around five thousand in all. Among his various sources were clearly either maps like the Peutinger map or lists of names along roads derived from such maps. Regardless of whether he took over names directly from maps himself, or whether this was done by previous compilers that he then copied from, it is obvious that the work was done in the most slapdash manner. Even so, two related observations seem beyond dispute. On the one hand, the frequency with which the names offered for an area by the cosmographer match those on the Peutinger map is striking. On the other hand, there are unmistakable instances where the listing of names is entirely comparable in character but cannot in fact derive from the Peutinger map. It marks only a handful of settlements on Sardinia and Corsica, for example, whereas the cosmographer lists a total of thirty-three there; elsewhere, there are entire regions which he covers (such as Arabia and Ethiopia), but the map does not. Altogether, there can be no question that his work is only made possible by maps incorporating the level of detail that the Peutinger map offers, as well as by itineraries and other lists that both underlay such maps and were compiled from them. Whether the Peutinger map itself was among the cosmographer's sources at either first or second hand is impossible to establish, and the issue hardly matters. Far more significant is the realization that well before about 700 CE various further maps of the same type had been produced, even though they may have differed in scope and shape.

A striking later product in the same tradition, dating to around 1050, is the large map produced at the abbey of Saint-Sever in Gascony (southwestern France) to illustrate a manuscript copy of the *Commentary on the Apocalypse* originally compiled by a Spanish monk, Beatus, in 776. The degree to which the 270 place-names on this map correspond to ones on the Peutinger map is unmistakable; evidently the designer at Saint-Sever is selecting from the kinds of maps and records of names that it represents. Further continuation of the tradition is apparent in the lost map known only from a detailed text about it, the *Descriptio Mappe Mundi* written in Paris by Hugh of Saint-Victor around 1135. The tradition is also reflected in the surviving Hereford Cathedral *mappamundi* produced around 1300.[28]

Second, the related impact of the Peutinger map was to demonstrate—as no map had done before so forcefully, perhaps—that a cartographer could not merely reshape the world drastically, but also do so in pursuit of aims that looked well beyond cartography. In short, this was a map that encouraged and empowered late antique and medieval mapmakers to devise further creative ways of giving their own work its intended impact. Christians in particular seized the opportunity. To suggest that Christian *mappaemundi* have their origin in the Peutinger map would be too sweeping and simplistic, but the map's radical cartography can be reckoned to make a formative contribution that has not been appreciated to date. As is well known, *mappaemundi* employ both texts and images to convey Christian history and belief within a geographic framework that need be no more than schematic and comes to be developed in a rich variety of forms.[29]

Testimony to the attention that the Peutinger map itself continued to receive is only now coming to be noticed too. The fact that the one copy known to us was nailed up for display sometime after it had been made around 1200, as mentioned above, is a novel observation made by Martin Steinmann. In addition, it has recently come to light that a

very similar map (but not identical, and now lost) was displayed along a wall in an anteroom in the bishop's residence at Padua around 1495. In my estimation there is also reason to believe that the maker of a map of Britain in the late thirteen century (known to us only through a mid-fourteenth-century copy, the so-called Gough map) had seen either the Peutinger map or one very similar, and that several of the remarkable features in his own design may reflect its influence.[30] Altogether, the Peutinger map can be considered to mark a pivotal transition from classical cartography to medieval—a creative advance in the former, a stimulus for the latter to develop its own distinctiveness. Its recognition as Roman work of lasting cartographic and cultural inspiration is long overdue.

# SEVEN

## Putting the World in Order: Mapping in Roman Texts

**Benet Salway**

The scanty survival of genuinely contemporary cartographic artifacts from Roman antiquity thrusts the simple textual description of geography into the limelight. While there is no denying the existence and public display of the grand cartographic visualizations discussed in the previous chapter, the dearth of surviving maps and diagrams frequently forces us to rely upon the examination of purely textual sources for evidence of "worldview," whether explicitly expressed by them or embedded in their structure. Indeed, the paucity of direct evidence for visual mapping has led some modern scholars to downplay the role of graphic illustration in the description of geographic information by the Romans.[1] Such a view is encouraged by the prominence of itinerary lists in the surviving literature, giving rise to the idea that the Romans' perception of the world was primarily linear, organized as so-called hodological space.[2] However, the use of itineraries to record or present routes for travel need not be incompatible with the consultation of maps, map-based thinking, or general "map consciousness" in other contexts.[3]

This chapter sets out to examine a wide range of texts from Roman antiquity (in Greek and Latin) both for signs of map consciousness and for evidence of its nature. Specifically, the descriptive logic of the texts will be examined for evidence of the sort of picture of the world that the educated Roman carried around in his or her head.[4] For example, on what was it centered? In which direction was it orientated? Was a cartographic image of the world even common at all? Obviously the answers to these questions will have been different at different times and locations across Roman history. They are likely to have differed between public and private contexts and varied according to personal education. They may well have differed, too, depending upon whether the world was being imagined on a global, regional, or simply local scale. Although the survey will encompass literary works, the emphasis will be upon less self-conscious technical, subliterary, and documentary material. The theme has been explored before.[5] The material, despite being scattered, is relatively plentiful and well known, so that this will be an exercise in sampling rather than a comprehensive examination.[6] The primary contribution of this fresh analysis will be to consider the literary and subliterary material together over an extended time frame stretching from the third or second century BCE to the sixth century CE. Treating these disparate materials together may appear an undisciplined and incoherent approach but, in accordance with the principles of Brian Harley (2001), the analysis will attempt to treat each within its proper social and cultural context.

### Cultural and Chronological Parameters

"Roman texts" constitute, of course, a rather broad category. It requires some further

definition, but its openness is deliberate, as we shall be ranging widely across works of very disparate character. They vary greatly in genre, authorship, and language—literary and documentary, official and private, Greek and Latin. They survive via a wide range of media—inscriptions on stone and bronze, even bone, and writings on papyrus, as well as the more familiar medieval manuscript tradition. The only group largely and deliberately set aside here is that of scripture and scriptural exegesis (whether Jewish or Christian). The rise and predominance of Christianity as a cultural force by the end of the period under consideration are undeniable phenomena, and the inclusion of religious texts within the survey could no doubt only enrich its findings. However, it would also threaten to distract from the purpose of elucidating traditional, secular Roman cultural practice rather than Judeo-Christian perspectives.[7] As it is, the texts discussed span a long period, during which the Roman world grew from being merely one of the powers in the western Mediterranean to becoming the supreme power there and in continental Europe from the first century BCE to the fifth CE, only to retreat once again to being a primarily Mediterranean power. At the same time the *res publica Romana* developed from a pagan city-state to a Christian empire. Over such a broad spectrum of social and cultural development, it would be unreasonable to expect a consistent worldview to be expressed. Nor is it necessarily reasonable to expect the same practices to be applied to the different purposes of general description of the world (geography), description of discrete regions or local areas (chorography), and the compilation of way-finding itineraries. Nevertheless, it might be an a priori assumption that "Roman" authors would tend to view the world relative to the standpoint of the capital. In fact, as we shall see, this is surprisingly uncommon.

A complicating factor is that the "Romanness" of the mapping encountered in texts emanating from the Roman world cannot be taken for granted. First of all, as in many areas of Roman culture, in matters of geography there was an acknowledged debt to Greek models. Nevertheless, for those texts that are the output of Roman authorities, whether central or provincial, their Romanness is relatively unproblematic. However, in the case of literary works, the matter is less straightforward. It is not so much one of language (Latin versus Greek) as of political and cultural identity. In the Greek east, because the acquisition or inheritance of Roman citizenship was frequently not accompanied by knowledge of the Latin language, let alone by any great familiarity with Italian culture, many individuals who considered being Roman one component of their identity were no different culturally from the mass of noncitizens around them. Conversely, certain authors of some significant surviving works of geography written within the Roman world were not just non-Roman by citizenship, but also would probably have shuddered to find their work branded as a product of Roman culture. Before the extension (in 212 CE) of Roman citizenship to most free subjects who did not yet possess it, non-Roman (mostly Greek-speaking) writers active under Roman rule varied greatly in their engagement with the contemporary political framework.

The point applies as much in the realm of geography as it does in others. At one end of the spectrum stands Claudius Ptolemaeus (Ptolemy), an Alexandrian Greek—and to judge from his name Claudius almost certainly a Roman citizen—of the later second century CE, who produced a mathematically plotted cartographic description of the contemporary world discussed in chapter 4 above. At the other end stands his slightly older contemporary, Pausanias, an Ionian Greek whose description (*Periegesis*) of Greece (an area he called by the name Hellas, not the contemporary Roman provincial designation Achaia) largely eschews mention of the Roman context.[8] Somewhere

between the two stands the Cappadocian Greek author of the first quarter of the first century CE, Strabo of Amasia, who explicitly acknowledges contemporary political reality in his *Geography* (see chap. 3 above) without necessarily being straightforwardly philo-Roman.[9]

We need to keep this spectrum in mind when assessing the extent to which there might be an identifiably Roman approach. Nevertheless, there is some coherence to the range of texts surveyed: all are Roman in the sense of being produced within the varying extent of the dominion of Rome, all engage more or less with that Roman context, and most are demonstrably by Roman citizens, even if not natives of the metropolis or of Italy. Of the various standpoints represented, that of members of the educated public is best represented (in literary works). By contrast, the standpoint of the Roman government (insofar as it is legitimate to think of such an entity) is least well represented, glimpsed only sporadically through chance documentary survivals or embedded in the official naming of political units.

The texts examined exhibit a range of relationships with maps. Some of those that survive may originally have accompanied maps. The most conspicuous example is Ptolemy's *Geography*, written in Alexandria in the late second century CE. Its text provides the method and data to construct both overview and regional maps, and it formed the basis for the Renaissance atlas tradition, but no illustrated manuscript survives from antiquity. By contrast, although it has been argued that the verse *Periēgēsis* (Guide around) or *Periodos gēs* (Route around the earth) by Ptolemy's fellow Alexandrian Dionysius is intended as an *ekphrasis* (explanation) accompanying a graphic illustration, the evidence is ambiguous, and the maps found in the medieval manuscripts do not match the text.[10]

Even so, more generally there is strong circumstantial evidence that works akin to modern atlases did circulate, whether or not Ptolemy's work carried illustrations. Two enigmatic Latin texts, entitled the *Dimensuratio* (better *Demensuratio*) *provinciarum* (Measuring out of the provinces) and the *Divisio orbis terrarum* (Division of the world), are best understood as comprising the captions (*commentarii*) that once belonged to a series of individual regional maps.[11] Both works are made up of short entries, each devoted to named regions and ending with figures in Roman miles for maximum longitude and latitude, which would have provided the reader with an idea of the relative scale of each region, since they were no doubt depicted on columns of equal width (if a scroll) or on pages of equal size (if a *codex*). Although there is a great deal in common between the data provided by the two works, they differ in the number and order of captions, so that they are witnesses to two different Latin atlas traditions, both now lost.[12]

Conversely, as with Dionysius Periegetes, some of the maps and diagrams that do illustrate medieval manuscripts of classical works are clearly not original to their design.[13] Moreover, graphic visualization of geographic data does not necessarily equate to cartography by modern definitions, as the example of the Dura parchment illustrates (fig. 7.1 and plate 9). This piece of parchment, used as shield decoration, was preserved in the dry conditions of the Roman fort of Dura on the Euphrates in Syria. Part of the design depicts a maritime itinerary along the coast of the Black Sea, the surviving portion running clockwise from Odessos (modern Varna in Bulgaria) at the top to Arta (the Straits of Kerch, or Cimmerian Bosphorus, between the Crimean peninsula and Russia) at the bottom.[14] However, while indubitably Roman by date, archaeological context, and textual content (the distances are indicated in *mil(ia)*, i.e., Roman miles, not

Greek stades), as an artifact it is arguably decorative rather than cartographic. Without illustrations, how can we diagnose "map consciousness" in texts? It might be characterized by the organization of geographic data in a manner that is coherent in terms of spatial awareness. Occasionally a text may display this cartographic quality because it has actually been derived from a map, but in most cases it is likely that textual descriptions were simply composed according to a mental visualization of the world that authors could reasonably expect their readers to share.

## Greek Heritage

Anyone who has opened a textbook on Roman history will be familiar with illustrations in which the political divisions of the empire are mapped onto a modern cartographic projection of Europe and the Mediterranean basin (for example, fig. 7.2). As it happens, Rome appears here more or less central horizontally as well as vertically, just as London (or more precisely Greenwich) does, longitudinally at least, in modern projections of the world. London's placement is, of course, the product of the British chauvinistically placing themselves as the initial reference point and eventually convincing everybody else (even the French) to follow suit. However, in the Roman case such central placement was essentially fortuitous. For, as already noted, the Romans' understanding of geography was influenced by Greek culture, to which the Romans themselves were peripheral. As Georgia Irby demonstrates in chapter 3 above, by the classical period a view of the "circle of the world" was common, in which a landmass divided into three continents (*ēpeiroi* in Greek) surrounding, but not entirely enclosing, the Mediterranean was itself surrounded by the outer sea (*Ōkeanos*). The Pillars of Hercules (Straits of Gibraltar) provided the natural demarcation of Europe from Africa (Libyē in Greek), while the rivers Tanais (the modern Don) and Nile were generally considered to mark the transitions from Europe to Asia and Asia to Africa respectively. Advances in knowledge and science meant that by the Hellenistic period the earlier "world" had been reduced to just one portion of the entire globe. This known part came to be termed the *oikoumenē*, "habitable zone," one of two such zones that were postulated north and south of the equator. Dicaearchus imagined that this *oikoumenē* was intersected by a principal east-west axis (*diaphragma*) that ran from the Pillars of Hercules to the Levant and then along the line of the Taurus Mountains, which were thought to extend on into the Caucasus and the Himalayas, as seen in the Peutinger map; Alexandrian scientists added a north-south axis through Byzantium, Rhodes, Alexandria, and Syene. It was this image of the world, glimpsed by us in the surviving fragments of Eratosthenes's writings, that educated Romans of the second century BCE inherited when Rome emerged as the dominant power in the Mediterranean.[15] They identified the Greek concept of the *oikoumenē* with the Latin notion of the "globe of the earth" (*orbis terrae* or *terrarum*).

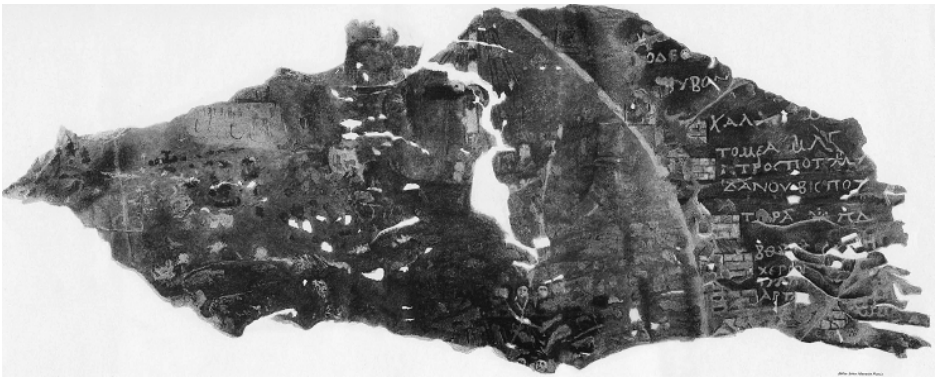


FIGURE 7.1 The Dura parchment (Paris, Bibliothèque Nationale de France ms. Supplément grec 1354[2], V). Insert illustration bound with F. Cumont, “Fragment de bouclier portant une liste d’étapes,” *Syria* 6, no. 1 (1925): 1–15.

Following Hellenistic tradition, knowledge of geometry (“earth measuring”) remained a standard part of the formation of an educated Roman, as late antique educational manuals demonstrate. Both Martianus Capella[16] in the early fifth century and Cassiodorus in the mid-sixth include geometry, alongside arithmetic, music, and astronomy, as part of the advanced curriculum (the *quadrivium*).[17] While the *ars gromatica* (art of surveying) was an area in which Roman science seems unusually to have been genuinely independent of Greek learning, the large scale geometry of the earth remained dominated by Greek authors, albeit through translations.[18] Cassiodorus specifically prescribed among “cosmographers to be read by monks” (*cosmographos legendos a monachis*) the “map” (*pinax*) of Dionysius Periegetes and, for more advanced students, the “book” (*codex*) of Ptolemy.[19] Even though Dionysius had not been Roman by citizenship (unlike his compatriot Ptolemy), his description of the world in 1,186 lines of hexameter verse, written under Hadrian in the early second century CE, is likely to have been more influential generally in forming the worldview of educated Romans.[20]

FIGURE 7.2 Map of the regions of Italy and provinces of the Roman empire ca. 200 CE, including the disposition of the legions as listed on the Maffeian column (fig. 7.13 below). Adapted by the author from R. J. A. Talbert, ed., *Atlas of Classical History* (London: Croom Helm, 1985), 170–71.

As Cassiodorus's instructions show, Ptolemy was reserved for further study despite (or because of) his scientific superiority. By contrast, Dionysius's *Periēgēsis* became a staple of the later Roman classroom in the Latin west as much as in the Greek east, being translated into Latin twice, once in the fourth century by the pagan senator Rufius Festus Avienus and again in the sixth by the Christian grammarian Priscian of Iol Caesarea (modern Cherchel in Algeria).[21] The work's popularity no doubt derived from its mapping of mythology onto a contemporary understanding of the world, making it a perfect companion to the study of epic poetry. However, unlike Ptolemy later, who incorporated the latest knowledge of the Far East, Dionysius perpetuated the traditional *oikoumenē* of Eratosthenes that extended only as far as India. Nevertheless, an awareness of the Chinese (*Seres*) did penetrate to the most basic level of instruction, as exemplified by the *Liber memorialis* of Lucius Ampelius, written in the second or third century CE.[22] It functioned as an elementary compendium of universal knowledge, perhaps for learning by rote. Astronomy and geography are included among the preliminary matter. Here, after treating the cosmos, constellations, stars, and winds, Ampelius includes a section on the *orbis terrarum* (sec. 6), before embarking on the bulk of the work, which is devoted to a digest of history down to the time of Trajan.

## Textual versus Graphic Mapping

It is perhaps best to start with some observations on the fundamental differences between graphic and textual representation of the world. Although a labeled map encourages reading from left to right (at least in Greek or Latin), which might in turn equate to reading from west to east depending upon orientation, a purely textual

description of geographic data imposes many more constraints on how they are to be read. We can compare, for example, the Roman governor Arrian's *Circumnavigation of the Black Sea*, written in the 130s CE,[23] with the fragmentary Dura parchment from the mid-third century CE mentioned above. Both describe stations along the Black Sea coast (fig. 7.3). The viewer of the parchment can begin at any point and "read" in either direction. As an author, however, Arrian had to make choices and the reader is compelled to follow—in this case anticlockwise from the Thracian Bosphorus. The need for him to choose a starting point, an order of description, and an ending point has useful consequences nevertheless. Unless they are completely arbitrary, his choices can offer insight into authorial viewpoint at least, if not into more widely held understandings of the proper organization and hierarchization of space.

## PRINCIPLES OF ORDERING

In order to assess the significance of the choices made by the writers or compilers of our texts in describing the world around them, we need first to consider the range of possible options. Above all, it must be remembered that there are alternatives to the organization of intrinsically geographic data according to a spatial principle. Given his intended purpose, the fourth-century scholar and bishop Eusebius of Caesarea naturally organized his gazetteer (*Onomasticon*) of places in the Holy Land as an alphabetical lexicon,[24] and Stephanus of Byzantium in the sixth century did the same for his guide to the proper forms of the names of peoples.[25] In his great encyclopaedia, the *Natural History*, the Roman *eques* ("knight"), Pliny the Elder, appears to have utilized *digestiones in litteras*—alphabetically organized statistical lists—of the communities of individual provinces and regions, compiled by the Roman authorities since at least the end of the first century BCE.[26]

Indeed, alphabetical order can be found lurking in unexpected places. The final chapters of the tetrarchs' edict on maximum prices from 301 CE state maximum rates for the transport of goods by sea along a network of routes spanning the length and breadth of the Mediterranean and into the Black Sea.[27] These routes are organized into a series of significant departure points that comprise a mixture of specific ports and more broadly defined regions. In Latin, which was certainly the language of the authoritative version of the edict, the order of the place-names—Alexandria, Oriens, Asia, Africa, Roma, Sicilia, Nicomedia, Byzantium—does not respect a consistent geographic principle. Even so, it can be read convincingly as reflecting a recognized hierarchy of importance from the viewpoint of a shipper based in the eastern Mediterranean, where the edict as a whole was certainly compiled.[28] Leaving aside Nicomedia, whose otherwise unexpected prominence is comprehensible given the presence there of the emperor Diocletian's court, all the others have traditional claims to be ranked among the most significant hubs in maritime transport and commerce. However, if the list is translated into Greek, the natural language of maritime matters especially in the eastern Mediterranean, it emerges that alphabetical order—Alexandreia, Anatolē, Asia, Libyē, Rōmē, Sikelia, Nikomēdeia, Byzantion—may be a simpler explanation; in addition, the data for the routes may have been recovered from an alphabetized filing system.[29] If so, then both Nicomedia and Byzantium are exposed as addenda to the core list—Nicomedia for the reason just suggested. Byzantium may bring up the rear out of alphabetical order, having been considered outside the Mediterranean group and signaling rather the gateway to the Black Sea.

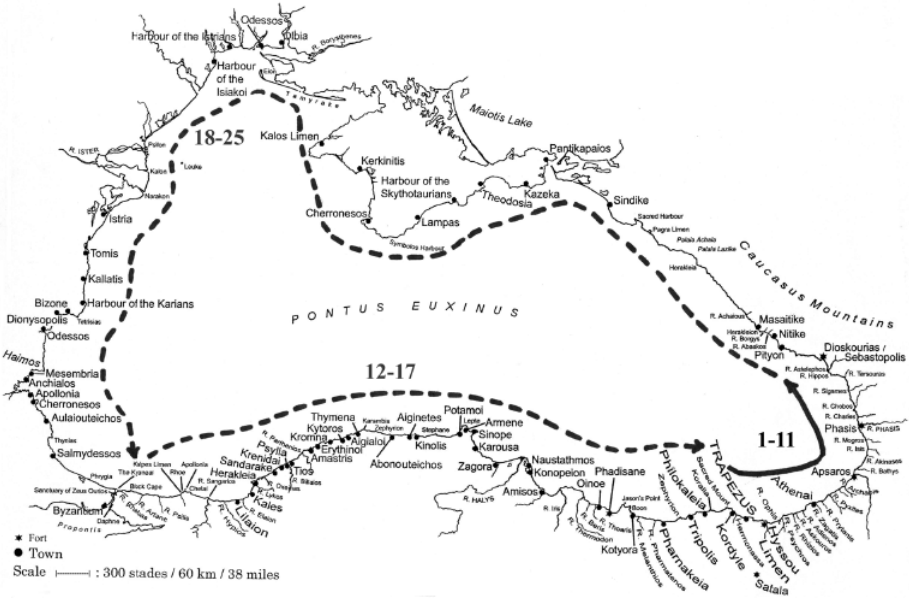



FIGURE 7.3 The circumnavigation of the Black Sea as recounted by Arrian, *Periplus Maris Euxini*, in a firsthand report (1–11) and a secondhand description (12–25). Adapted by the author from A. Liddle, ed. and trans., *Arrian, Periplus Ponti Euxini* (London: Bristol Classical Press, 2003), 136–39, maps 1–2.

As well as alphabetical or numerical order, a hierarchy of status may override purely geographic considerations. Several documents expose the habits of the Late Roman administration in this respect. The first is the famous *Notitia Dignitatum*, which preserves a version from around 400 CE of the list of senior government offices maintained by a palace official, the *primicerius notariorum*. It exhibits a basic binary division into eastern and western parts, reflecting the political division of the empire since 395 between the emperors Arcadius and Honorius.[30] Priority is given to the east over the west, no doubt because of Arcadius's seniority to his brother in the imperial college. As the lists of contents of the two halves show, the provincial administration is described primarily in order of the rank of the posts and then only within each rank with reference to geography. In the eastern list, within each of the grades (praetorian prefects, proconsuls, *vicarii*, *comites rei militaris*, *duces*, consular governors, and ordinary *praesides* and *correctores*) the posts are listed by prefecture and their constituent administrative dioceses (groups of provinces) in an anticlockwise order from Libya (Cyrenaica) to the Danube: Aegyptiaca, Oriens, Asiana, Pontica, Thracia, Macedonia, Dacia. Its western counterpart is not quite so consistent, but the predominant order of dioceses is Pannoniae, Italiae, Africa, Hispaniae, Septem Provinciae-Galliae, Britanniae. Within each diocese, there is often some geographic logic to the order in which provinces are listed; however, this is subordinated first to ranking by dignity of governor and, in the case of subdivided provinces, to numerical sequence. For instance, the list of the provinces of the diocese of Galliae is headed by Lugdunensis Prima, under a *consularis*, followed by Germania Prima and Secunda, Belgica Prima and Secunda, Alpes Poeninae et Graiae, Maxima Sequanorum, Lugdunensis Secunda, Tertia, and Senonia, all under *praesides* (*Not. Dig. Occ.* 3.14–31).

The roughly contemporary *Notitia Galliarum*, which lists just the provinces of the two

dioceses of Gaul (see fig. 7.4), is much more successful in blending respect for political hierarchy and numerical sequence with geographic coherence.[31] Here, although geographic contiguity is still subservient to the other criteria, the provinces of Galliae and Septem Provinciae are listed in clockwise and anticlockwise sequences respectively. So Galliae, for instance, is described in the order: Lugdunensis Prima, Secunda, Tertia, and Senonia, Belgica Prima and Secunda, Germania Prima and Secunda, Maxima Sequanorum, and Alpes Graiae et Poeninae (*Not. Gall.* 1–10).

Another document comparable to the *Notitia Dignitatum* is a schedule (*notitia*) of fees to be paid by those appointed to various provincial commands within the praetorian prefecture of Oriens that is appended to *Novel* 8 of the emperor Justinian, dated 15 April 535. Here the offices are again grouped according to grade in order of descending dignity, rather than by physical proximity, from the *vir spectabilis comes Orientis*, through the consular governors, to the ordinary *praesides* and *correctores*.[32] Similarly, as in the *Notitia Dignitatum*, within this framework there is some evidence of organization according to administrative dioceses in an anticlockwise geographic order from Africa to Europe (Aegyptus, Oriens, Asiana, Pontica, Thracia), but it is not consistently applied.

FIGURE 7.4 The Roman provinces of Gaul in the fifth century CE. Map by the author.

The discipline of these official lists contrasts with the much less organized presentation of the same sort of material in the mid-fifth-century *Laterculus* of Polemius Silvius, a retired palace official, who groups his lists of provinces thus: Italia, Galliae, Africa, Hispania, Illyricum, Thracia, Asia, Oriens, Pontus, Aegyptus, Britannia.[33] However, in contrast to the dry listings in official documents that do not intend to be geographically helpful, Polemius does provide his readers with some occasional geographic context of a very basic kind. For example, in Gaul, where he was writing, he notes, under Belgica Secunda (2.9), "It is from here that the crossing to Britain is made" (*de qua transitur ad Britanniam*), while both Germania Prima and Secunda (2.10–11) are noted as "on the Rhine" (*super Rhenum*), and Lugdunensis Secunda and Tertia (2.13–14) as both "on the Ocean" (*super Oceanum*). At the end of the Spanish section, he records that Mauretania Tingitana (4.7) is "across the strait, which flooded by the ocean divides the lands between Calpe and Abinna" (*trans fretum, quod ab oceano infusum terras intrat inter Calpem vel Abinnam*). In Illyricum, Dalmatia (5.1) is "on the sea" (*super mare*), while Noricum Ripense (5.9) is "on the Danube" (*super Danuvium*). In the east, Cilicia (8.5) "abuts the Taurus mountains" (*iuxta montem Taurum*), and Mesopotamia (8.7) is

"between the Tigris and Euphrates" (*inter Tigrim vel Eufraten*). All of these points, if they are to be any help, assume that the reader has a basic grasp of the physical geography of the Roman world.

## ITINERARIES

Another form of list particularly associated with the Roman mindset is the itinerary.[34] These are found used for planning and recording routes, and even for commemorating individual journeys. As in later periods, these simple one-dimensional enumerations of stops with intervening distances served a practical purpose for Romans in describing routes or recording specific journeys.[35] Maritime itineraries (*periploi*) have a long history in the Greek world, and they continued to be produced by and for Hellenophone shippers under Roman rule.[36] Most famous is the anonymous description of the trade route from Egypt to India via the monsoon winds known as the *Periplus of the Red Sea*, written in the mid-first century CE.[37]

However, it is itineraries for land travel that predominate in the Roman tradition. Two notable texts, recording journeys made by individuals, happen to survive from within little more than a decade of each other in the early fourth century CE. First, among the memoranda generated by the journey of one Theophanes from Hermopolis Magna in Egypt to Antioch in Syria and back some time in the period between 322 and 324, are his records of the stops made and distances covered.[38] Second, the account of an anonymous traveler from Bordeaux to the Holy Land and back again, dated to 333, has been transmitted via the medieval manuscript tradition.[39] Here the bare list of stops and distances has been annotated by the traveler to indicate his or her use of places, mostly as either an overnight stop (*mansio*) or a change of mount (*mutatio*); the section about Palestine, however, expands into a full-blown tourist narrative.[40] Three centuries or so earlier, several travelers from Spain to Rome had their itineraries of just over a hundred stages from Gades (Cadiz) to the capital vividly commemorated by being engraved on four silver beakers (see, for example, fig. 7.5). These would appear to have then been ritually deposited, perhaps in thanksgiving for safe completion of the trip, because they were retrieved in modern times from the waters of a spring at the Bagni di Vicarello on the Lago di Bracciano in South Etruria.[41] The framing of the columns of the text on each beaker by imitations of architectural elements suggests that the design may be modeled on a monument, perhaps one that stood in Gades displaying the itinerary to Rome.

FIGURE 7.5 One of the silver beakers from the Bagni di Vicarello: *Corpus Inscriptionum Latinarum* XI 3281, headed "ITINER | ARIVM | A GADES | ROMAM." Rome, Museo Nazionale delle Terme, inv. No. 67497. Berlin-Brandenburgische Akademie der Wissenschaften, Corpus Inscriptionum Latinarum archive. Reproduced with permission.

The existence of such public displays of itinerary lists is demonstrated by the fragment of an octagonal column from Tongeren (Atuatuca Tungrorum) in modern Belgium (fig. 7.6).[42] It presents lists of stations along several routes in the region of northern Gaul in the same fashion as the Vicarello beakers and the archive of Theophanes, that is, as simple names with scarcely any contextualizing references to physical or political geography, let alone explicit statements about direction. For example, in the seventh line

of the central column the entry *Isara l(eugae) XVI* (Isère 16 leagues) does not indicate that this is the name of a major river. Moreover, when the column's routes are mapped out, with attention paid to the direction of each, it becomes clear that they are not described as radiating out from Tongeren or even from any single consistent viewpoint (fig. 7.7). The routes through Antunnacum (Andernach) and Borbetomagus (Worms) in the first column, through Durocortorum (Reims) and Samarobriva (Amiens) in the second, and from Bagacum (Bavay) to Nemetacum (Arras) in the third might all conceivably depart from Tongeren, but then the route from Castellum Menapiorum (Cassel) to Nemetacum (Arras) clearly cannot. Such lists of itineraries might cumulatively describe a network of routes; without indications of direction or explicit signaling of junctions, however, they do not facilitate the "mapping" of the space traversed by their readers. Nevertheless, this method of point-to-point description, presenting the perspective of a traveler rather than a map reader, predominates in the remarkable geographic digressions of the late fourth-century historian Ammianus Marcellinus, despite the fact that he cites Ptolemy on at least one occasion (22.8.10).[43]

FIGURE 7.6 The pillar from Tongeren, Belgium: *Corpus Inscriptionum Latinarum* XIII 9158 = XVII/2 675. Brussels, Musées Royaux du Cinquantenaire. Berlin-Brandenburgische Akademie der Wissenschaften, Corpus Inscriptionum Latinarum archive. Reproduced with permission.

It was the major achievement of the anonymous compiler(s) of the collection of itineraries known as the Itinerarium Antonini, or Antonine Itinerary, which took its final form around 300 CE, to knit regional subcollections of itineraries together to form a network covering the length and breadth of the empire.[44] The seemingly chaotic agglomerations of itineraries, exhibiting switches in viewpoint of description reminiscent of the Tongeren pillar, and the variability in the nature of the material between sections strongly suggest that the collection was built up from disparate pieces of publicly circulating material rather than having been excerpted from central archives. Nevertheless, using such material, the compiler of the Antonine Itinerary collection was able to patch together fifteen distinct regional collections to form an ensemble that describes the Roman world in an anticlockwise direction from the Straits of Gibraltar to Britain, that is, from the western extreme of Africa to the northwestern fringe of Europe (see fig. 7.8). The result produces a superficial impression of coherence at the "oecumenical" level, even where individual "chorographic" components run counter to the general geographic tendency.[45]

FIGURE 7.7 The route network of the Tongeren pillar. Map by the author.

Although the Antonine Itinerary collection might seem confusing at a provincial level, one of the texts inscribed on a monument erected in honor of the emperor Claudius at Patara in Lycia in 45 or 46 CE demonstrates that it was possible to map the layout of a province using itineraries according to a consistent presentation.[46] Besides the dedication to the emperor on the narrow (front) face, the long left side (seen in fig. 7.9) and the opposite right side are covered with a remarkable Greek inscription listing sixty-five separate stretches, making up thirty itineraries, linking twenty significant places throughout the newly annexed province. The monument stood on the dockside at Patara, greeting new arrivals from abroad. The careful structure of the route network is best appreciated in the diagram in figure 7.10, where Arabic numerals label the thirty itineraries and letters indicate the twenty significant nodes.[47] Maintaining the overall primacy of Patara (the chief city of the province and location of the monument), the network is described by proceeding along the most westerly route to the next node and so on until the path is exhausted. Then, jumping back to the last significant node, the

next route out of town clockwise is followed, and so on. By this method the territory of the province is traversed from the west coast in a clockwise arc until it hits the east coast at Phaselis and Korydalla. Then, rather than double back to Patara, the description returns to the chief node and begins again with the next route anticlockwise out of Patara.

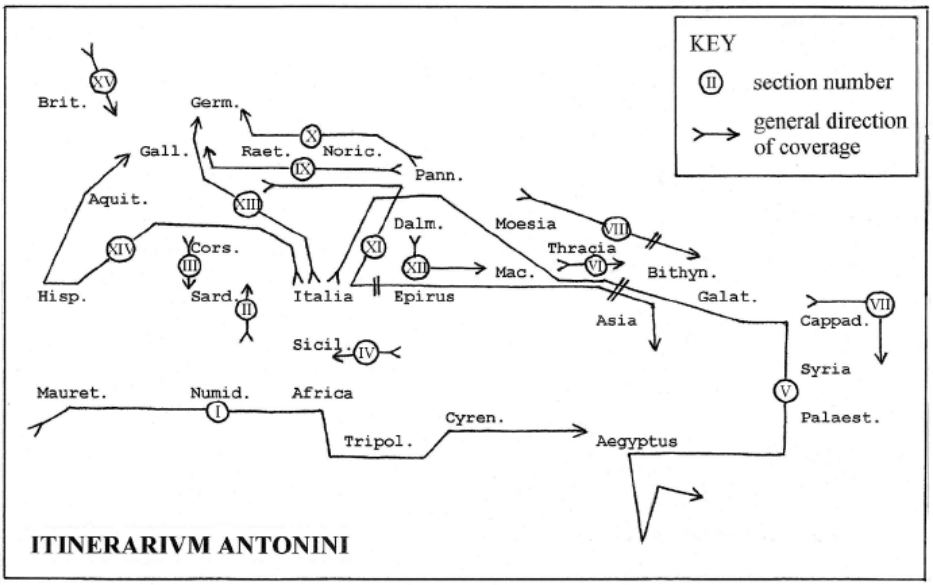



FIGURE 7.8 Schematic diagram of the structure of the Itinerarium Antonini. By the author.

There is a neatness and economy to this method that is not found in the Antonine Itinerary, but severe limitations to its usefulness as a practical guide to the traveler need to be recognized. The method results in the atomization of conveniently direct long-distance routes (Patara to Kaunos, say, or Patara to Kibyra) into relatively short and disjointed stretches. Had the compiler of the Antonine Itinerary subjected his component material to such ruthless editing, its utility would have been greatly undermined. This application at Patara of a rigorously consistent method of description at the expense of practical utility suggests that—as with the route network on the Peutinger map—the list of places on the monument was intended to impress by its extensiveness. Moreover, the beauty of the Claudian monument is that its physical location is identical with the viewpoint of the text inscribed on it.

FIGURE 7.9 Three-dimensional rendering by Fatih Onur of the left face (face B) of the Claudian monument from Patara, Lycia, bearing the list of the first thirty-nine stages of the route network. Reproduced from S. Şahin and M. Adak, *Stadiasmus Patarensis: Itinera Romana Provinciae Lyciae* (İstanbul: Ege Yayınları, 2007), p. 25. Reproduced with permission of Fatih Onur.

How the list on the monument was produced is an intriguing question. Since most of the distances are demonstrably calculated in Roman miles, it is likely that the data are not a pooling of preexisting information, but rather in large measure derive from a recently conducted survey of the new province.[48] Interestingly enough, it is easier to imagine the particular structure of the list being generated by reading off a sketch

diagram of the network of routes showing the relative position of each town in two dimensions; to generate this structure from conventional itinerary lists, by contrast, would require a considerable effort in splicing and recompiling. Thus, the Patara monument is perhaps now a stronger candidate for a text derived from consultation of a map than any other previously proposed.

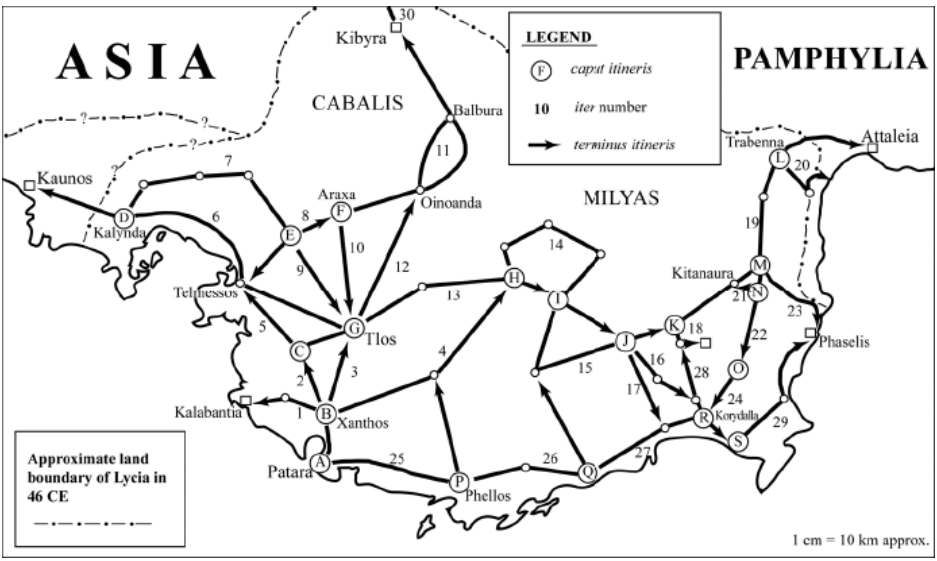



FIGURE 7.10 The route network of the Claudian monument from Patara. Map by the author.

A less strong candidate in this regard is the list of marine transport costs in the tetrarchs' maximum prices edict. Keith Hopkins had diagnosed it as an example of map-based thinking on two main grounds: first, the attribution of the same maximum price to a route from one port to another regardless of direction implied that no account was taken of the contrary effects of prevailing winds and currents depending on the direction of travel; second, inconsistencies of cost per unit of distance between routes could be attributed to inaccurate maps that overestimated the length of the western Mediterranean.[49] However, a recent alternative analysis by Pascal Arnaud concludes that there is some sensitivity to the different conditions between routes, and that the apparent artificiality of the pricing structure does not derive from reading a map but through simplification. The basic factor taken into account in calculating the cost was duration rather than distance. Direct routes are cheapest per unit; those that are segmented (i.e., pass through points at which transshipment is likely to have taken place) are more expensive.[50]

As the example of the Patara monument demonstrates, the one-dimensional itinerary, or *periplus*, had severe limitations when it came to describing the contours of a region. Accordingly, as noted in chapter 3 above, both Hellenistic and Roman writers were accustomed to communicating the two-dimensional outline of physical geographic regions by comparison with abstract geometric forms or the shape of everyday objects.

## Mapping the *Oikoumenē: The Continents*

As we have seen, educated Romans took over from classical and Hellenistic geographers the concept of a habitable world (*oikoumenē*) divided into three continents (Asia, Europe, and Africa) grouped around the Mediterranean Sea (*mare nostrum*—"our sea" in Roman terms), through which ran the central east-west axis (*diaphragma*), with the whole surrounded by the outer ocean. This identification of the *oikoumenē* was an easy one to make when the existence of India (and later China) was tacitly ignored. By the first century CE Roman power had sufficiently encompassed the Mediterranean world that it was easy enough for Romans and their subjects to pretend that their empire was synonymous with the entire *orbis terrarum*.[51] When Augustus (Rome's first emperor) died and his own account of his achievements was posthumously published, whoever posted up our most complete surviving copy in the province of Galatia headed it with the summary "An exemplar of the things achieved (*res gestae*) by the divine Augustus, by which he subjected the *orbis terrarum* to the authority of the Roman people, and of the expenditure that he made for the state and the Roman people."[52] On the monument from Patara discussed above, Claudius, famous as the first emperor to extend Roman power across the ocean to Britain, is celebrated as "the emperor of the *oikoumenē*."[53] The Jewish historian (and recent Roman citizen) Flavius Josephus, writing soon after 70 CE, has the Jewish king (and Roman citizen from birth) Agrippa II, speaking in 66, say "Throughout the *oikoumenē* all are Romans," even while referring to a Jewish population outside the Roman empire "beyond the Euphrates" (*Bell. Iud.* 2.388).[54] Aelius Aristides, a Greek orator from Pergamum, in his mid-second-century panegyric *To Rome*, similarly identifies the boundaries of the Roman empire, defended by a ring of fortifications, with the boundaries of the civilized world.[55]

Given such identification of Roman dominion with the *oikoumenē*, it seems surprising that Rome itself is not more often made the center or starting point for geographic descriptions. Even those authors most closely associated with the glorification and cataloging of the extent of Rome's dominion do not routinely appear to consider the city the *umbilicus orbis*, or geographic center, of the *oikoumenē*, as Greeks had once considered the national shrine at Delphi its *omphalos*. Strabo, writing in the early first century CE, comes close to such a formulation. Near the end of his *Geography* (17.3.4) he conceptualizes the Roman empire and the entire world as spreading in concentric circles around Rome: first Italy, then the regions around Italy in a circle (*kyklos*), and the three continents (Europe, Libya, and Asia). In a similar fashion, according to Richard Talbert in the previous chapter, the original scheme of the Peutinger map put Rome at the center not only vertically but also horizontally.

There were various potential options for subdividing descriptions of the entire Roman world according to differences in physical, political, or cultural and environmental geography. In physical terms, leaving aside grouping by continents for a moment, the Romans did on occasion categorize places as *loca maritima* (facing the sea), *media terrena* or *mediterranea* (inland),[56] or *ripensis* (facing a major river). However, writers of geographic treatises or of geographic digressions in historical works evidently did not make these differentiations. We do find one official legal source, the edict of an anonymous emperor, distinguishing Italy on the one hand from the *provinciae transalpinae et transmarinae* (provinces usually reached by travel over land or overseas) on the other.[57] This edict, preserved on a papyrus in Egypt, was clearly of interest to the inhabitants of that *provincia transmarina* because it established a differential in the time permitted for the referral of appeals from criminal trials to the emperor; those from Italy were permitted nine months, and those from the transalpine and transmarine provinces

eighteen months. Such a ruling clearly assumes an emperor primarily based in Rome, a situation best suited to the conditions of the first or second century CE. By the time that the papyrus copy was made (some time in the early third century perhaps), the ruling may indeed have been somewhat anachronistic.

In grouping descriptions, we might also expect reference to the fault lines of cultural geography that might be observed running through the Roman empire. If describing the same region of the world today, we might naturally organize countries into groupings of shared religious culture or of cognate languages. However, the first would not really work for the Roman world because, with the exception of the Jews and the increasingly ubiquitous Christians, its entire area was characterized by one form or another of polytheistic cult. Even so, there were two cultural fault lines that did run through the Roman world; both bisected it, one primarily east-west, the other north-south.[58] The horizontal divide was an environmental one separating the (mostly Mediterranean) provinces, whose staples were wheat, wine, and olive oil, from those in which the last two were replaced by beer and butter. The vertical divide was a linguistic one between the Latin "west" and the Greek "east" (a convenient shorthand much used by modern scholars), or to put it more precisely, between those areas in which the language of Roman government was Latin and those in which it was Greek. On the North African coast this divide separated the eastern and western arms of the Gulf of Sidra (in modern Libya), dividing Greek Cyrenaica from Latin Tripolitania. On the northern shore of the Mediterranean the Latin-Greek divide ran roughly east-northeast through southwestern Europe from the Adriatic to the Black Sea, dividing the Latin provinces of Dalmatia and Moesia from Greek Epirus, Macedonia, and Thrace. Real as these divides might be, we do not find them echoed in the geographic or historical literature, whose writers preferred to group descriptions according to continents or political units or both.

At this point, then, we should consider the role of the names of the three continents in Roman political toponymy or, as Ptolemy would no doubt term it, "choronomy." Of their three names, both Asia and Africa also served emblematically as labels for the provinces occupying the portions of those two continents nearest Rome—indeed, those areas where in the second century BCE Rome had gained its first intercontinental footholds. Such labeling arose from the nature of Roman provincial commands, which originated as conceptual theaters of operation allocated annually to Rome's senior magistrates. Only when these theaters came to be administered as permanent possessions did they take on concrete terrestrial form. This helps to explain why the term "Europe," despite its currency as a geographic concept, did not feature in the Romans' political geography as either a provincial or regional designation.[59] Given the physical location of Rome and Italy on the European continent, the term could not usefully serve to distinguish any sphere of responsibility from the empire's heartland. A rare example of the use of Europe to designate a group of territories in an official Roman context comes from a grant made by the masters of the Roman state in the mid 30s BCE, the triumvirs Mark Antony and Octavian ("Imperator Caesar"). The text survives (in Greek translation) inscribed on marble in honor of its beneficiary at his hometown Rhosus, an ancient port south of modern Iskenderun in the Gulf of Issus.[60] It grants Roman citizenship to a naval captain, Seleucus, in gratitude for his contribution to the defeat of the triumvirs' former rival Sextus Pompeius. Various other privileges are granted too, including freedom from customs dues on imports and exports to or from "a city or territory of the provinces of Asia and Europe" (line 48). The omission of Africa from the grant—for whatever reason—is interesting.

The earliest account of the continents to survive in Latin literature is that by the late republican senator Sallust. In his historical monograph on the Numidian king Jugurtha (written in the late 40s BCE), he sets the scene with a geographic and historical introduction to Africa as a continent (*Bell. Iug.* 17–19). It opens: "In dividing the *orbis terrae*, the majority put Africa as the third part (*pars tertia*), though a few recognise only Asia and Europe, putting Africa in with Europe." This initially rather surprising statement is echoed much later in the geographic introduction to the *Historiae adversus paganos* by Paulus Orosius, a Christian priest from northwest Spain. He wrote this history, in Africa as it happens, around 417 CE as an apologetic response to the pagan claim (prompted by the sack of Rome in 410) that Christianity had brought disaster to the Roman empire.[61] He explains (1.2.1) that "our ancestors conceived of the *orbis* of the whole *terra*, surrounded by the periphery of ocean, as tripartite (*triquetrus*) and called its three parts Asia, Europe, and Africa, although some conceived of two, that is, Asia and then Africa subsumed in with Europe."

Why might Africa be the third part, and why might it be merged with Europe? To those of us accustomed to thinking of these divisions as continents in the modern sense, the idea of merging Asia with Europe or with Africa on the basis of contiguity seems perfectly reasonable. By contrast, a merging of Africa with Europe—separated as they are by Asia at one end and the Straits of Gibraltar at the other—seems highly counterintuitive. However, the meaning of Sallust and Orosius can be illuminated by reference to the entry *De orbe* in the encyclopaedic dictionary that Isidore, bishop of Seville, compiled some time between 615 and 630 (*Etymologiae* 14.2.1–3).[62] He divides the *orbis* into three parts but explains that they are not equal: Asia extends from north to east, Europe from north to west, Africa from west to south. Accordingly Europe and Africa, divided into two regions by the Mediterranean, together occupy half the globe, Asia the other half by itself. So, if you divide the globe in two parts, the east and the west, Asia is in one, Europe and Africa in another. These, of course, are roughly the proportions found earlier in Eratosthenes as well as later in the so-called T-O tradition of early medieval maps, in which the circular landmass of the *oikoumenē* is divided unequally into the three continents in a fashion resembling a T placed in its bottom half.[63] However, as will emerge below, Orosius's viewpoint is slightly different.

Although six possible combinations exist for the order of the continents, only four are regularly attested: (1) Asia, Europe, Africa; (2) Europe, Asia, Africa; (3) Africa, Asia, Europe; and (4) Europe, Africa, Asia. The phraseology of Sallust and Orosius suggests that the first order had the authority of tradition, and it is found again in Isidore, among others.[64] I do not think that its coincidence with the alphabetical order of their names in Greek (Asia, Eurōpē, and Libyē) is of any great significance. The priority of Asia is easy enough to explain as both the largest and most easterly continent, nearest the rising sun. However, the general priority of Europe over Africa is puzzling. It runs counter to clock-(or sundial-)wise order, and if based on a viewpoint from the east it also runs counter to the left-right pattern of reading in Greek and Latin. Alternatively, if viewing from the east, as Orosius does (see below), the order Europe-Africa might reflect a preference for right over left, or from an objective viewpoint for north over south. Certainly the latter preference is seen in Julius Caesar's famous opening description of Gaul in his *Gallic War*, written at the end of 52 BCE. Here, after declaring "The whole of Gaul is divided into three parts," he describes its three constituent elements (the Belgae, Galli, and Aquitani) from northeast to southwest (1.3–1.7), which is certainly not the order in which he first encountered them.

Confirmation that Orosius's anticlockwise treatment of the world (starting from the east) represents a common tradition emerges from observation of the organization of a somewhat earlier work, the *Expositio* (*E*), or *Descriptio* (*D*), *totius mundi et gentium*, that is, "Explanation" or "Description of the whole world and peoples," composed in the late 350s.[65] This work is non-Christian (i.e., secular, if not explicitly pagan) and its author now anonymous, probably from the general region of Syria. Although originally written in Greek, it survives only in two Latin translations. It begins with the statement "We must first say what peoples are established from the east (*oriens*) to the west (*occidens*)" (*D 2*). It then proceeds to describe the peoples of Asia from the extreme east to Bithynia (*D* 4-*E/D* 49), then Europe from Thrace to Spain (*E/D* 50–59), and finally Africa from Mauretania to Cyrenaica (*E/D* 60–62), with an appendix on major islands east to west from Cyprus to Britain (*E/D* 63–67).

The second order—Europe, Asia, Africa—is also well attested. Its arrangement may be explained by its indebtedness to the Greek *periplus* tradition, as exemplified by Hecataeus.[66] Thus, Strabo's *Geography* describes the world clockwise from Spain through Europe to the Black Sea, then southward through Asia to finish in Africa.[67] Similarly, Pliny the Elder begins the geographic books of his *Natural History* at the Straits of Gibraltar and treats the continents in the order Europe, Asia, Africa. However, he differs slightly in pursuing an anticlockwise description of Europe along its Mediterranean and Black Sea shores, before heading up the Danube and down the Rhine, followed by an anticlockwise *periplus* of the southern and eastern coasts of the Mediterranean and Aegean around to the Black Sea and across to Persia, followed by a *periplus* of *Oceanus* clockwise back around to west Africa. The same order of continental description is found in the *Divisio orbis terrarum* and Martianus Capella. In this company, the otherwise derivative Iulius Solinus stands out. His *Collection of Memorable Things*, written soon after 200 CE and almost entirely cribbed from Mela and above all Pliny, deviates from Pliny in starting at Rome.[68] His other significant innovation betrays a further unconventional perspective. While most Romans tended to view the world from a maritime viewpoint and hence used the term *mediterraneus* to refer to inland regions, Solinus is the first to invert this perspective and refer to the "Mediterranean" as just that, "the inland sea."[69]

The third order—Africa, Asia, Europe—is found in the *Chorographia* of Pomponius Mela, a Roman from southern Spain writing in the 40s CE.[70] Again eschewing Rome as a starting point, his work is organized as an anticlockwise *periplus* of the Mediterranean from the Pillars of Hercules (Straits of Gibraltar), followed by a clockwise *periplus* of the outer ocean back to the Pillars. His starting point may reflect a local perspective (as was common in Greek *periploi* of the Roman period),[71] but it also has its own logic. As noted above, an anticlockwise *periplus* of the Mediterranean from Mauretania to Spain is found in the Antonine Itinerary too. The third order also occurs in one Greek writer with some pretensions to high style. The boundaries of the Roman empire are described according to that order by Aelius Aristides in his panegyric *To Rome* (82).

The fourth order—Europe, Africa, Asia—is best attested among Greek writers. As already noted, Strabo cites it toward the end of his *Geography* (17.3.4). More complex, however, is the organization of the geographic preface to the history written in Greek by the Roman citizen and *eques* Appian in the mid-second century. He manages to maintain an anticlockwise direction consistently throughout his account of the limits (*horoi*) of Rome's empire. Like his close contemporary and fellow Alexandrian Ptolemy, he begins in Rome's northwestern extreme (Britain), and by making two overlapping circuits he ends up back at his starting point. After Britain and the Atlantic coast of Gaul and Spain,

he describes the provinces surrounding the Mediterranean in an anticlockwise *periplus*, and then the landward (desert and river) frontiers of Africa, Syria, and the Danube and Rhine provinces. The most famous proponent of the fourth order is, of course, Ptolemy. Even so, we should not allow the fact that he represents the pinnacle of Greco-Roman geographic science to seduce us into assuming that his choice was typical.

## Orientation and Viewpoint

It is evident from the Peutinger map and from the geographic digressions in several Latin authors that Eratosthenes's *oikoumenē* was the model onto which many educated Romans mapped their understanding of the world. However, since most of these authors were careful to use objective terminology (north, south, east, west) rather than subjective (left, right, up, down), it is seldom possible to determine whether they shared the northern orientation preferred by the theoretical geographers and seen, for instance, in the layout of the Peutinger map. Today, of course, we are accustomed to orientation toward the north and (in languages written in scripts derived from Greek or Latin) to reading from left to right. Other things being equal, these norms ought to favor description from north to south and west to east. Indeed, with the extra refinement of grouping coverage by continent (in the fourth order above, Europe, Africa, Asia), this is exactly what we find in the ordering of Ptolemy's twenty-six regional maps, which begin with the British Isles and end with Taprobane (modern Sri Lanka). The general arrangement suits the left-to-right reading order of a papyrus roll. It is also uncannily similar to the organization adopted by Richard Talbert for the *Barrington Atlas* (2000) when he faced exactly the same challenge.

However, despite seeming so logical, this arrangement cannot be safely assumed to represent the contemporary norm in antiquity. After all, Ptolemy was deliberately attempting to produce an objective description of the known world—hence his decision to abandon the prime meridian through Alexandria (used previously for his celestial mapping in the *Almagest*) for one through the furthest westerly point he knew, the Fortunate Isles (modern Las Canarias).[72] Those with less lofty aims might be more influenced by their everyday experience of the natural world. Accordingly, if they looked to the sky, they might reasonably imitate the sun's daily trajectory, so that descriptions would start with the rising sun (the east) and end with the setting sun (the west). In addition, we might expect a southerly orientation and, perhaps, a clockwise order of description, following the arc of the sun (as viewed from the perspective of the Northern Hemisphere) through the southern sky. This orientation we do see in Egypt, where the sun and the river Nile, rising in the south, both had enormous religious and cultural significance. On the other hand, if they looked to the night sky, then the revolution of the constellations around the North Pole might suggest a northerly orientation, as followed by Ptolemy, who came to geography through astronomy. If they looked to the ground, it would be equally reasonable to follow the trajectory of shadows, as on a sundial, clockwise from west to east through a northerly arc.

In the medieval tradition, the east (the location of Paradise/Eden)[73] is frequently given pride of place at the top of *mappae mundi*. Earlier, among the classical Latin geographers, Sallust's use of objective terminology in his account of the continents is unrevealing, but we are fortunate that Orosius is less objective. He explains (1.2.3): "This part [i.e., Asia] facing west touches on its right (*a dextra*) Europe, beginning below the north pole, while to the left it stretches out to Africa." So Orosius is inviting his reader to

imagine looking from an eastern perspective along the *diaphragma*, with Europe to the right (north), Africa to the left (south). This perspective is far from universal, however. Not only did Ptolemy and other theoretical geographers favor orientation to the north, but it is found too in the *Expositio/Descriptio totius mundi et gentium*, whose anonymous writer explicitly locates Egypt "to the left (*de laeva parte*) of Syria" (*E/D* 34) and Arabia "to the right (*de/a dextris*) of Syria" (*E/D* 38). By contrast, another late antique pagan author and Orosius's approximate contemporary, Martianus Capella, in his digest of geometric knowledge shares the eastern orientation of the later medieval Christian tradition: he unequivocally puts Europe to the right of the Pillars of Hercules and Africa to the left (6.624). The fact that he offers his observations as part of a synopsis of traditional learning in an entirely secular context suggests that the orientation of the later T-O and *mappa mundi* traditions may represent a continuity with pagan antiquity (even if a coincidental one), rather than a new departure, and that Orosius is idiosyncratic in his westerly orientation.

## *SUPERIOR* AND *INFERIOR* IN ROMAN POLITICAL GEOGRAPHY

The importance of this east-west axis (Levant to the Pillars of Hercules) to Greco-Roman geographic thinking was emphasized in a recent paper by Glen Bowersock (2005), where he offers a useful starting point but not, as he admits, the last word on the subject. Further evidence for his central thesis can indeed be found in an utterance placed in the mouth of the Roman emperor Justinian by his speech-writer (*quaestor*), Tribonian. This passage comes from the preamble to a new law on senatorial membership (*Novel* 62) issued in December 537; although meant as a historical statement, it has to be read in the context of the newly confident empire, resurgent after the reconquest of Africa and initial successes in Italy. Tribonian produced a neat formulation to describe the basic divisions of the Roman world into east and west and northern and southern shores of the Mediterranean: "Roman power extended not only to the risings and settings of the sun (*non solum ad ortus solis et occasus*) but also to both flanks (*sed etiam in utrumque latus*) of the *orbis terrae*." Given the immediately preceding contrast with east-west, by *latera* (flanks) he clearly means the northern and southern halves of the *oikoumenē*, lying to either side of the *diaphragma*.

This said, I think that Bowersock pushes his evidence too far in claiming that the pivotal importance of the Mediterranean, or of a maritime reference point more generally, lies behind the use of the terms *superior* (upper) and *inferior* (lower) in Roman political geography. These terms were used in the imperial period to distinguish two parts of previously single provinces, as happened in Germany, Moesia, Pannonia, Britain, and eventually Cyrenaica (see fig. 7.2). This usage has sometimes been explained with reference to elevation from sea level, and that certainly works for the riparian provinces Germany, Moesia, and Pannonia, where the superior province is upstream from the inferior one. However, the explanation clearly does not work for Britain, where there is no obvious riverine reference point and the superior province lay in the lowland south, the inferior in the upland north. Nor will it work in terms of relative military force. While Pannonia Superior and Britannia Superior ended up with greater numbers of legions than their *inferior* counterparts, the first such provinces to be divided, Germany and Moesia, had equal establishments. It is tempting to imagine that *superior* might reflect proximity to the central *diaphragma*, but the stumbling block to this explanation is the order of the Pannonias.

Instead, Bowersock prefers a new nuance on the first ("upstream") theory just mentioned. He would have *inferior* indicate proximity to the *sea* of reference, be it the

Mediterranean, Black Sea, or German (i.e., North) Sea. Ingenious as his nuance is, he still struggles to explain the order of Britain and especially of Libya Superior and Inferior (the subdivided Cyrenaica), where *superior* lies to the west, *inferior* to the east, though both are equally Mediterranean. I contend that the real explanation is to be found in the history of the naming of Roman provincial divisions. In the republican period this was done with explicit reference to Rome as the viewpoint. When Spain was divided into two commands, it was natural that the eastern portion should be *citerior* (nearer) and the western *ulterior* (further), likewise that Gaul be thought of as being divided into one portion on the side of the Alps closer to Rome (Cisalpina) and another beyond (Transalpina). With regard to the question of the *superior-inferior* distinction, therefore, suffice it to observe that in every case the superior province is geographically closer to Rome than the inferior.[74] Such a Rome-centered perspective is hardly surprising in official terminology. It also helps to explain the phasing out of this system of distinctions during the fourth century CE. By then, the further subdivision of traditional provinces, combined with the multiplication of imperial courts (none of which might be based in Rome) culminating in the foundation of Constantinople, rendered the traditional binary divide obsolete. *Superior* and *inferior* were superseded by the more neutral and flexible *prima* and *secunda*, which allowed for the creation of a *tertia* or otherwise-designated extra subdivision, as in Britain (Britannia Prima and Secunda, Flavia and Maxima Caesariensis). This transformation in terminology had begun, but was not yet complete, by the time of the compilation of the so-called Verona List (discussed below), which may be dated to 314.[75]

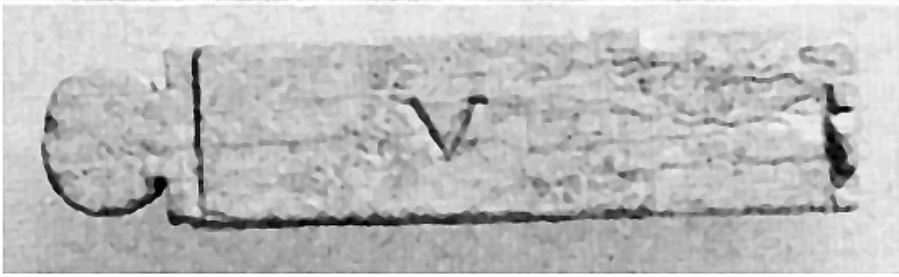
## THE ORDERING OF TRIBES AND REGIONS

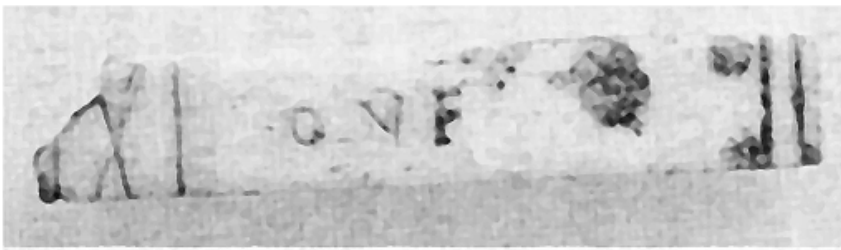
Aside from the republican and early imperial provincial designations, a Rome-based standpoint can also be detected in the ordering of two sets of official territorial units: the thirty-five voting tribes of the Roman republic and the nine regions of Italy in Augustus's time. It is well known that the four "urban" and thirty-one "rural" tribes created up to 242 BCE represented territorial subdivisions of the *populus Romanus*, spanning central Italy from south Etruria to Campania and from the Tyrrhenian Sea to the Adriatic coast. It is also well known from scattered allusions that the tribes had a particular order. But this could not be established in its entirety until Michael Crawford recognized the significance of two bone *tesserae* in the British Museum and was then able to reconstruct it in a recent paper (2002). On these *tesserae* (or counters) the standard abbreviations for the names of two tribes—ROM for Romilia and OVF for Oufentina—are twinned with the numerals five and sixteen, respectively (see fig. 7.11). Putting all the evidence together, Crawford realized that the rural tribes had been numbered according to their positions along the major public roads leaving Rome, from nearest to furthest, and in an anticlockwise direction starting from the Romilia on the road to Ostia, Rome's port at the mouth of the Tiber and first-ever colony, around to the Arnensis on the coast of south Etruria.

The location of the starting point southwest of Rome in this instance finds a counterpart in the southeast orientation of the marble plan of the city made around 200 CE and discussed in the previous chapter. It took the alignment of the Via Latina in the direction of the sanctuary of Iuppiter Latiaris in the Alban hills as its point of reference. This alignment corresponds with the starting point for the anticlockwise numeration of the fourteen regions of the city of Rome, established by Augustus in 7 BCE.[76] Crawford has suggested that the same anticlockwise sequence also conditioned the numbering of the regional subdivisions of Italy that were created in the first century BCE. The nine of

these in peninsular Italy were numbered in an anticlockwise direction from Regio I, Latium et Campania, to Regio IX, Liguria (see fig. 7.2).[77]

On a much more local level, a further paper by Crawford (2003) has noted the same tendency to anticlockwise description by those engaged in the definition of community boundaries, one of the jobs of the *agrimensores* (surveyors), a profession discussed by Michael Lewis in chapter 5 above. A treatise by Hyginus preserved in the late antique collection of their technical writings (the *Corpus Agrimensorum*) suggests the types of place where boundary markers (*termini*) might be placed, but it does not specify a particular direction to follow.[78] A famous early example of the definition of territory in this way is the bronze tablet dug up at a village called Pedemonte, north of Genoa in Liguria, in the early sixteenth century.[79] This inscription, known generally as the *Sententia Minuciorum*, preserves a judgment delivered in 117 BCE by the Roman commissioners Quintus and Marcus Minucius Rufus concerning the dispute between the Genuates (the Genoese) and their inland neighbors, the Langenses Viturii. Their territory straddled the Via Postumia, the Roman highway that ran northward from the coast over the Apennine watershed into the upper Po valley. The record contains an outlining (*determinatio*) of the locations where *termini* should be placed. It demarcates two concentric circuits: an inner one (indicated by the letters *a* to *d* in fig. 7.12) delimiting the *ager privatus* (private fields) of the Langenses, and an outer one (indicated by the numbers 1–15) fixing the borders of their *ager publicus* (i.e., common pasture and woodlands). In recent times two of the boundary markers have been identified, still very close to the sites dictated by the text (at nos. 13 and 14). Both *determinationes* begin at the south of the territory and follow an anticlockwise path.



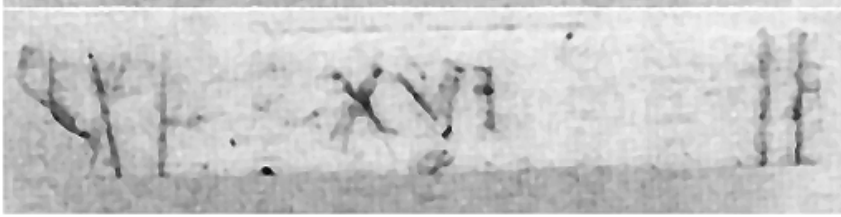




FIGURE 7.11 The bone *tesserae* ROM/V and OVF/XVI (British Museum). From M. H. Crawford, "Tribus, tessères et régions," *Comptes rendus des séances, Académie des Inscriptions et Belles-Lettres* 2002, p. 1127, fig. 1.

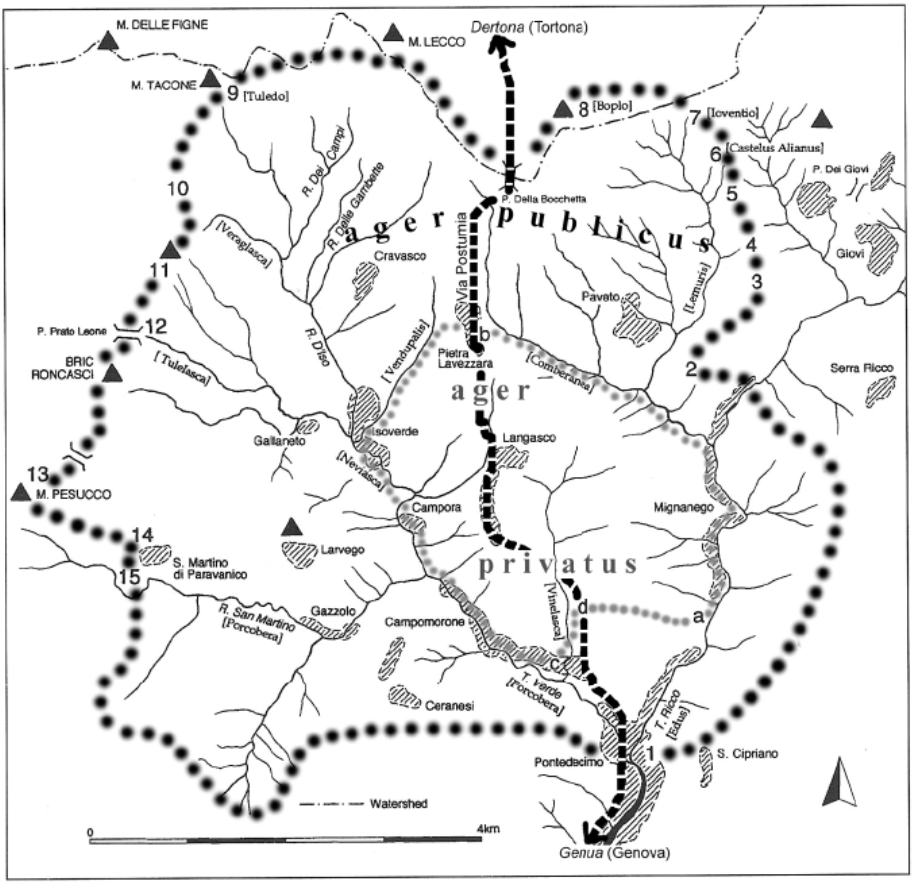



FIGURE 7.12 The approximate boundaries of private land (*a–d*) and public land (1–15) within the territory of the Langenses Viturii, as described in the *Sententia Minuciorum*: *Corpus Inscriptionum Latinarum* $I^2$ 584 = V 7749. Adapted by the author from M. H. Crawford, "Language and Geography in the *Sententia Minuciorum*," *Athenaeum* 91 (2003): 208, map 2.

The same practice can be observed in a *determinatio* (or *horothesía* in Greek) issued in 100 CE by the governor of Moesia Inferior, Laberius Maximus, to the city of Histria (near the mouths of the Danube), as part of the settlement of its dispute with the imperial contractor who collected the customs dues of the "Thracian shore" (*portorium ripae Thraciae*).[80] Here, although the demarcation starts at the north, the order is again anticlockwise; a southerly start would in any case have been precluded by the coastline. It may be that with the Roman tribes, Italian regions, and outlines of the territories of the Langenses and Histriani, it was the major watercourse (the rivers Tiber, Porcobera, and Danube, respectively) that dictated the starting point in each case.

Moving from the local to the provincial scale, two principles of organization can be observed in the description of the province of Asia found in the Roman customs law for the province.[81] Although this law only survives in a Greek version, inscribed at Ephesus in 62 CE or soon after, it is an indubitably Roman document (the preamble makes clear that the text is derived from official archives at Rome) comprising an accretion of regulations going back at least as far as 75 BCE. To this earliest layer belongs a definition of the area covered by the customs regulations (lines 7–8 §1), that is, the coast and the

borders of Cappadocia, Galatia, and Bithynia, an order implying an anticlockwise description beginning and ending in the north. This order is subsequently confirmed by the detailed listing of maritime customs stations from the mouth of the Black Sea to Side in Pamphylia (lines 23–26, §9). A more subjective viewpoint is taken in a later section, dating from 17 BCE, that enumerates the "dioceses" (administrative subdistricts) of the province of Asia (lines 88–91 §39). Here, Ephesus, the chief city of the province, is taken as the primary point of reference, as the districts are listed first in a southerly direction (Ephesus, Miletus, Halicarnassus), then in a northerly one (Smyrna, Adramytium, Hellespontus), and finally in a westerly one (Sardis, Cibyra, Apamea, Synnada, Lycaonia). This enumeration may offer us a glimpse into the organization of the *formula provinciae* (register of the province) maintained in central financial archives at Rome, a category of source material generally assumed to have been exploited by Pliny the Elder around 70 CE for the geographic sections of his *Natural History*.[82] If Pliny is any guide to these *formulae*, then they would appear to have organized different categories of material according to varying logic. For example, in his description of Gallia Narbonensis (modern Provence), Pliny lists the regions (*regiones*) occupied by tribal groupings in geographic order clockwise from the Pyrenees to the Alps, Roman colonies by date of foundation, and then towns of Latin status alphabetically.[83]

## THE ORDERING OF LEGIONS

On an empire-wide scale, we gain another glimpse into the geographic world-view of the Roman filing clerk with the so-called Maffeian column (fig. 7.13). Now preserved in the Vatican's Gallerie lapidarie, this column originally stood in the Basilica Aemilia on the north side of the Roman Forum.[84] On it, under the heading *nomina leg(ionum)* (names of the legions), are inscribed the names of the thirty-three legions as they existed around 200 CE, disposed in three equal columns of eleven names. Each legion in the Roman imperial army always had its own number and epithet, both of which might be shared by other legions but not in the same combination (e.g., Prima Adiutrix, Secunda Adiutrix, Prima Italica, Secunda Italica). So, in principle, it would be possible to draw up a list in combined numerical and alphabetical order, as indeed the early third-century historian Cassius Dio does (55.23). In fact, embedded in the final layout of the column is a geographically organized document drawn up around 170 (see table).

Here the names of the three "Parthian" legions created in the 190s during the Parthian campaigns of Septimius Severus (two stationed in Mesopotamia and one at Albanum, south of Rome) have been added across the bottom (cols 1–3, line 11), while the names of II and III Italica, raised for Marcus Aurelius's wars against the Marcomanni in the 170s (based in Raetia and Noricum), appear at the end of the third column (lines 9–10). Otherwise the remaining twenty-eight legions in fact form a coherent geographic sequence from II Augusta at Caerleon in South Wales (col. 1, line 1) to VII Gemina at León in Spain (col. 3, line 8). The legions are grouped by province, delineating the frontiers of the empire in a clockwise sequence circling Rome and the Mediterranean (as indicated in fig. 7.2): Britain (col. 1, lines 1–3), Germany (lines 4–7), Pannonia (col. 1, lines 8–10; col. 2, line 1), Moesia (lines 2–6), Dacia (line 7), Cappadocia (lines 8–9), Syria (col. 2, line 10; col. 3, lines 1–2), Judaea (lines 3–4), Arabia (line 5), Egypt (line 6), Numidia (line 7), Hispania Tarraconensis (line 8). As with the Claudian monument from Patara, the physical location of the column is in harmony with the focal point of the list displayed on it. Within each province the legions are listed upward by number, rather than according to any geographic sequence. So, for Britain, II Augusta (Isca/Caerleon) precedes VI Victrix (Eburacum/York) and XX Valeria Victrix (Deva/Chester). However,

as is clearest from the ordering of the legions in the divided province of Germany, the logical priority of “Superior” over “Inferior” has been allowed to disturb the geographic logic, so that the army of the more southerly Germania Superior (VIII Augusta, XXII Primigenia) is listed before that of its northern neighbor Germania Inferior (I Minervia, XXX Ulpia).

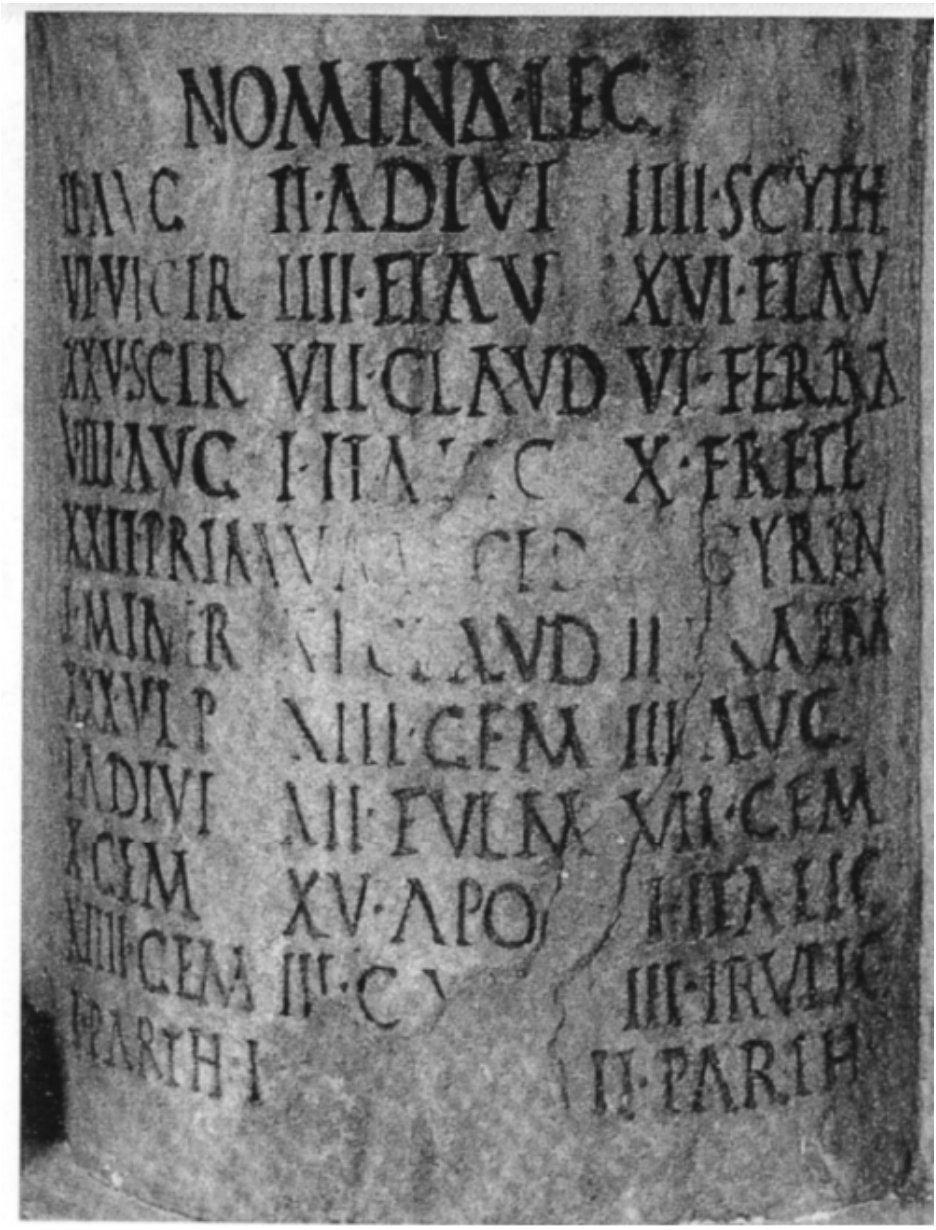



FIGURE 7.13 The Maffeian column listing the Roman legions around 200 CE: *Corpus Inscriptionum Latinarum* VI 3492 = 32901. Vatican, Musei Vaticani, Galleria lapidaria inv. 7460. From P. Cosme, “Les légions romaines sur le forum: Recherches sur la colonnette mafféienne,” *Mélanges de l’École Française de Rome—Antiquité* 106 (1994):

172, fig. 1a.

Nomina leg(ionum)

| | | | |
|---|---|---|---|
| | II Aug(usta) | II Adiut(rix) | IIII Scyth(ica) |
| 2 | VI Victr(ix) | IIII Flav(ia) | XVI Flav(ia) |
| | XX Victr(ix) | VII Claud(ia) | VI Ferra(ta) |
| 4 | VIII Aug(usta) | I Italic(a) | X Frete(nsis) |
| | XXII Prim(igenia) | V Maced(onica) | [III] Cyren(aica) |
| 6 | I Miner(via) | XI Claud(ia) | II Traian(a) |
| | XXX Ulp(ia) | XIII Gem(ina) | III Aug(usta) |
| 8 | I Adiut(rix) | XII Fulm(inata) | VII Gem(ina) |
| | X Gem(ina) | XV Apol(linaris) | II Italic(a) |
| 10 | XIIII Gem(ina) | III Gal[l(ica)] | III Italic(a) |
| | I Parth(ica) | I[I Parth(ica)] | III Parth(ica) |

The list's starting point—Britain—is strikingly reminiscent of the near-contemporary *Geography* of Ptolemy. But influence from it is unlikely because the Maffeian column takes Asia and Africa in the order opposite to Ptolemy's and, in fact, seems deliberately to ignore organization by continent when this principle could quite easily have been respected. Continental coherence had been similarly disregarded in the account of the disposition of Roman military forces in 23 CE by the senatorial historian of the late first and early second century Cornelius Tacitus (*Annals* 4.5). Although he began at an equivalent point (Germany; Britain still lay outside the empire), he chose to describe legionary deployment in an anticlockwise manner: from Germany to Spain, across to Africa, and round to Egypt, Syria, and Cappadocia, before crossing back into Europe with Thrace, the Danube provinces, and Dalmatia, to finish in Rome with the urban and praetorian cohorts. In contrast to both Tacitus and the Maffeian column, a Roman theoretical geographer might have preferred to begin with III Augusta at Lambaesis in Numidia, follow the legions around anticlockwise through Asia, and finish in Europe with Spain or Britain.

## THE ORDERING OF PROVINCES IN THE LATE EMPIRE

Official documents reflect the political fragmentation of the empire during the later Roman period in multiple viewpoints. A prime example is the Verona List, so called not because it was written in Verona but because it survives uniquely in a manuscript preserved in the chapter house library there. This list plausibly derives from an official record generated at one of the early fourth-century imperial courts or regional administrative centers. It comprises a list of the names of all the provinces of the empire around 314, organized according to the twelve regional groupings of them called "dioceses" (as mapped out in fig. 7.14).[85] However, although the twelve are presented here in a single list, they are not ordered in a single geographic sequence, but rather in two separate eastern and western groups, reflecting the respective spheres of responsibility of the emperors Licinius and Constantine during the period between Licinius's defeat of Maximinus in 313 and his own defeat in his first civil war with Constantine in 316–317. Licinius's (eastern) group of dioceses—Oriens, Pontica, Asiana, Thraciae, Moesiae, Pannoniae—precedes that of Constantine: Britanniae, Galliae, Viennensis, Italiae, Hispaniae, Africa. The split is apparent from the discontinuity midway in the list between the dioceses of Pannoniae and Britanniae. The eastern half of the list circles the Mediterranean neatly anticlockwise from south to north or, in continental terms, from Africa, through Asia, to Europe. The arrangement of the western

half is less tidy, though it is approximately anticlockwise from north to south or from Europe to Africa, since the diocese of Hispaniae in fact spanned the Straits of Gibraltar to include the province of Mauretania Tingitana.

Within the dioceses of Licinius's portion the provinces are listed according to geographic sequence, though not according to any consistent pattern. The internal organization of Constantine's portion is less tidy geographically, but there is little evidence that geographic sequence has been subordinated to political hierarchy, as seen in the *Notitia Dignitatum* and the schedule to Justinian's *Novel* 8, both discussed above. The priority given to the eastern half of the list contrasts with the Maffeian column (which starts in Britain) and is all the more unexpected in view of the difference in status between the two emperors at the time. As contemporary inscriptions from Licinius's portion of the empire demonstrate, even though Licinius had once considered himself senior to Constantine, in this period he now acknowledged him as his senior.[86] In the Verona List, as we have it, the inversion of the expected order suggests that a special significance is being accorded to the eastern half of the empire, therefore, perhaps reflecting a place of writing or editing within Licinius's realm. In fact, the list's structure becomes far more comprehensible if the two halves are reversed. So either our copy derives from a version that suffered accidental dislocation in transmission; or it may preserve a deliberately manipulated "eastern" redaction of a document that in its original state did respect the contemporary political hierarchy as well as geographic logic. With a west-east (Constantine-Licinius) order restored, the list flows from Britain in a single anticlockwise sequence through western Europe, Africa, and Asia, around to eastern Europe. This result is decidedly more elegant, even if it no more respects the continental divisions than did the Maffeian column.

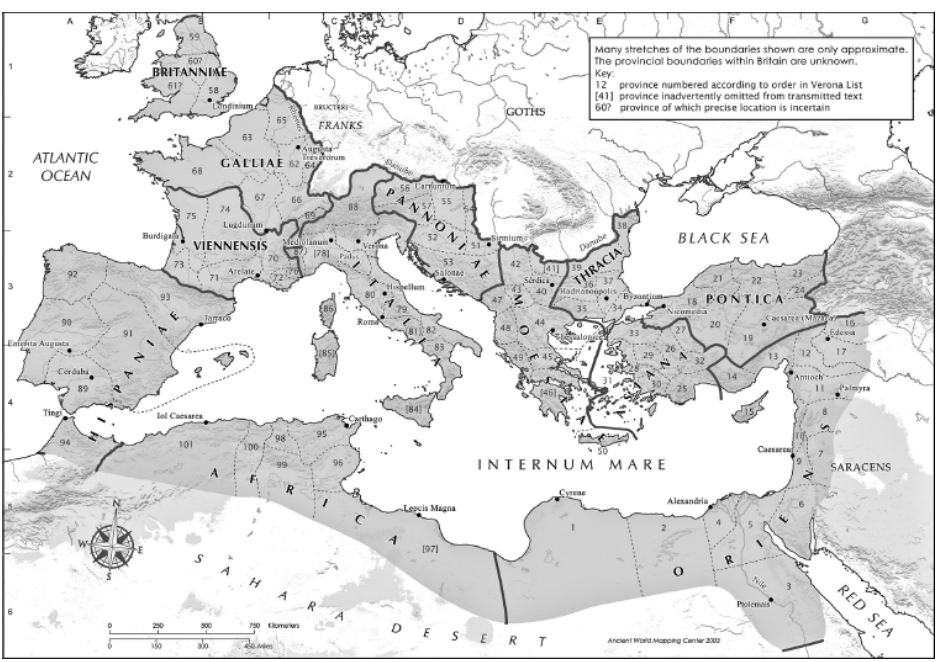



FIGURE 7.14 The provinces and dioceses of the empire according to the Verona List, ca. 314 CE. Map adapted by the author from original made by the Ancient World Mapping Center, University of North Carolina, Chapel Hill, and reproduced with permission.

## Geography and History

The ancient writers who attempted to blend history with comprehensive accounts of geography set themselves a much tougher task than those that simply described snapshots of the world at a single moment, or those literary authors, such as Sallust, Appian, and Orosius, that confined their geography to discrete sections. A famous example is the speech (mentioned above) that was put in the mouth of Agrippa II by Josephus. Since the king had corresponded with Josephus during the writing of his account and had received a presentation copy of the *Jewish War* when it was finished, Josephus's version of the speech may be more faithful to the original than is usual in Greco-Roman writing. In attempting to dissuade the Jews from revolt, Agrippa reminds the crowd in Jerusalem of the vast scope and military resources of the Roman empire. He begins his historical account of Rome's expansion with the conquest of Greece and Macedonia, when Rome first penetrated the sphere of the Hellenistic kingdoms to which Judaea had also been subject, and thus when Romans are first likely to have impinged on Jewish consciousness.[87] He then traces a rather undisciplined quasi figure eight around the *oikoumenē*, describing Asia Minor, the Balkans, Gaul, Spain, Germany, Britain, and then jumping to the North African provinces before ending closer to home on the Euphrates.[88]

In very similar fashion, a geographic tour of the Roman world is related as part of the personal history of a military veteran of the tetrarchic period, Aurelius Gaius, on the tombstone that he erected for his wife, Iulia Arescusa, near Cotiaeum in Phrygia around 300.[89] Having listed his advancement through the ranks, he says that he had "circled the empire" (*tēn hēgemonian kykleusas*), a claim that he then expands upon with a list of at least twenty-three provinces, two cities, and four regions beyond the empire's borders: "Asia, Caria [Lycia?, Phrygia?], Lydia, Lycaonia, Cilicia [Isauria?, Armenia?], Phoenicia, Syria, Arabia, Palestine, [Egypt?], Alexandria, India (i.e., Ethiopia), [- - -], Mesopotamia, Ca[ppadocia, Pontus?], Galatia, Bithynia, Thrace, [- - -], Moesia, Carpia, [- - -], Sarmatia four times, Viminacium, [- - -], Gothia twice, Germa[ny, - - -, Darda]nia, Dalmatia, Pannonia, [- - -], Gaul, Spain, Mauretania, [- - -]." The list starts close to home, taking a clockwise sweep to the southernmost point (India, which probably means the Red Sea coast of Ethiopia), then an anticlockwise sweep passing through the easternmost point (Mesopotamia) to the northernmost (Germany), before beginning anew with an east-to-west account from the central Balkans to the westernmost points in Spain and Mauretania. As the references to repeated forays into enemy territory demonstrate, this is not a simple chronological itinerary, but represents a consolidated account that avoids repeated mention of any single locality. Rather, the list is artfully constructed to emphasise the extent of his travels in relation to his own starting point (the text gives his birthplace as Pessinus, also in Phrygia), which is close to that of the location of the audience for the tombstone in the territory of Cotiaeum. In this context, it is understandable that the toponymy of more familiar nearby regions (Caria, Lydia, Lycaonia) defines smaller units than that of distant places, which sometimes names dioceses rather than individual provinces (Gaul, Spain). The choice of the term "India" also suggests an attempt to emphasise the exotic.

Much more sophisticated is the often underrated *Breviarium* dedicated by the Roman official Festus of Tridentum to the inadequately educated emperor Valens around 370.[90] This pamphlet is nothing less than a crash course in geopolitical history from the

foundation of Rome to the emperor's current Persian campaigns. Despite its brief compass, Festus manages to weave an account of the rise of Roman power seamlessly into a roughly clockwise and extremely economical tour of the Roman world that ends appropriately with Valens's current theater of operations.[91] In retrospect, the work's only fault was to encourage the emperor in his thinking that the recently defeated Goths were a spent force, a judgment that was to be proven dramatically wrong at the battle of Hadrianople (Edirne) in 378, with immediately fatal consequences for the emperor and (it might be argued) chronically terminal ones for the empire.

This survey of mapping in Roman texts closes with a work that may seem preternaturally unprepossessing as well as archetypally Byzantine rather than Roman in a traditional sense: the *Synekdēmos* of Hierocles, written in Greek and most probably in Rome's younger sister and rival, Constantinople. It is a documentary text, comprising lists of cities organized by provinces and dioceses as they existed in about 500.[92] It is offered as a description of "that part of the Roman world under the dominion of Constantinople," but no further explanation of its purpose or organizing principle is ventured. Mapping out the data of this gazetteer (as in fig. 7.15) is not necessarily immediately enlightening. Given its relatively even quality throughout, the information plausibly derives from an official source of some kind, as did the earlier Verona List. The work has also been carefully executed.

In fact, the arrangement of the *Synekdēmos* reflects a synthesis of political and theoretical geography. Although Hierocles notes the status of each province's governor, he still prefers a geographic sequence. Within each diocese, the provinces are consistently presented in a roughly clockwise order, where the Verona List had no consistent pattern. Moreover, within each province, after the metropolis, the cities are listed according to a recognizable geographic logic. At a higher level, too, the order of description is independent of the imperial government's official understanding of the world. In the two centuries since the Verona List had been compiled, an extra tier of organization had been superimposed. In consequence, as already seen in the *Notitia Dignitatum*, the dioceses had by now been grouped into prefectures, each headed by one of the emperor's praetorian prefects. In the later fourth century three such territorial prefectures had embraced the empire between them: (from east to west) the praetorian prefect of the east (Oriens); the praetorian prefect of Italy, Africa, and Illyricum in the center; and the praetorian prefect of the Gauls (Galliae) in the west. However, the division of the empire at the end of the fourth century, followed by the implosion of its western half before the end of the fifth, had left its eastern half divided into two very unequal prefectures, that of Oriens (based at Constantinople and controlling the diocese of Thrace as well as the four dioceses east of the Bosphorus), and the much smaller, two-diocese prefecture of Illyricum (based at Thessalonica). The division between these two prefectures is marked by the double line on the map.

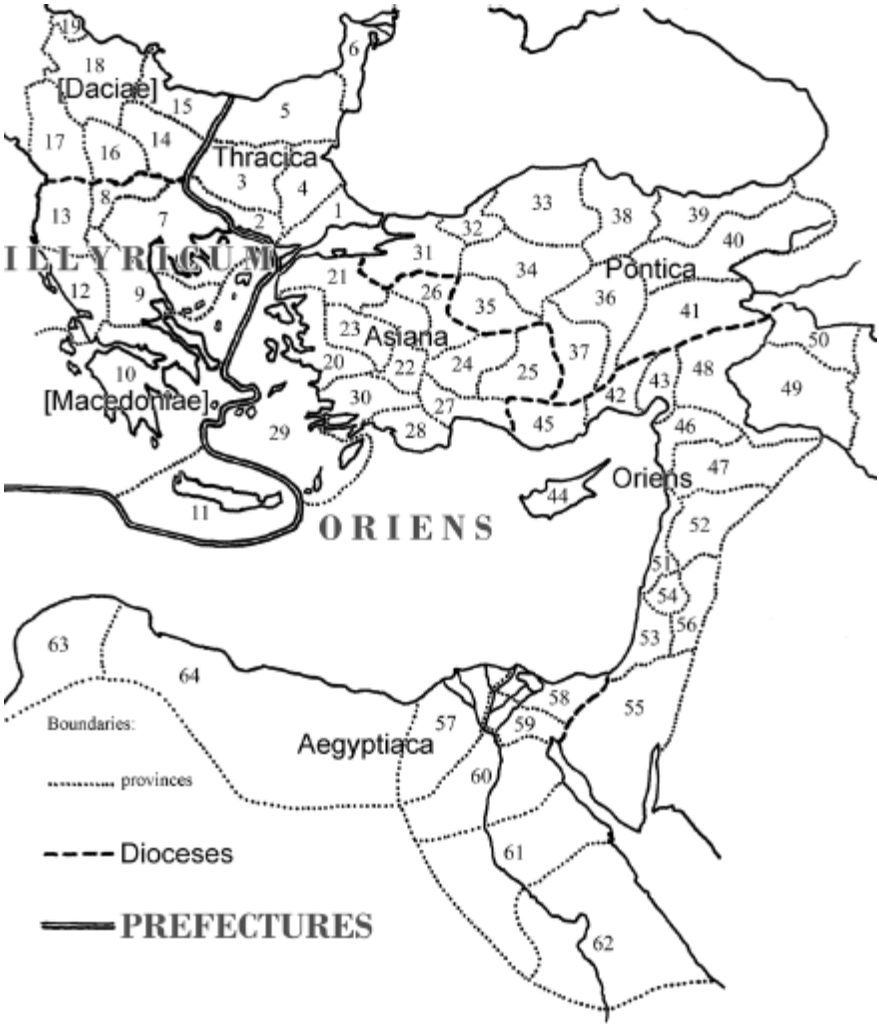



FIGURE 7.15 The provinces of the eastern Roman empire ca. 440–500 CE, as cataloged in Hierocles's *Synekdēmos*. Map by the author.

The prefect of Oriens was considered senior to that of Illyricum, and his name always took precedence in official protocols.[93] Accordingly, we might expect Hierocles to describe the whole of Oriens before turning his attention to Illyricum. However, after beginning with the province of Europa and then the rest of Thrace, he turns his attention to the prefecture of Illyricum before resuming the description of Oriens. Here, moreover, he does not start with the provinces of the Pontic diocese immediately over the Bosphorus from Constantinople, but in Asiana with the province of Asia.[94] So not only has he transcended contemporary political geography by treating the dioceses of the continent of Europe together, but he has also sought symmetry by beginning the description of each continent with its eponymous province. The prioritization of Europe over Asia was no doubt influenced by the physical location of the capital on the west side of the Bosphorus. By understanding Hierocles's rationale, it is possible to appreciate his work as a sophisticated blend of political and theoretical geography rather than a mere catalog. Given the cartographic nature of its arrangement, it is hard to imagine that his description was not influenced by consultation of a map.

## Conclusion

The analysis of often superficially unsophisticated material, nestled in the interstices between more visually striking artifacts, can be utilized to reveal some underlying themes in the Romans' perception of the world around them. Of course, what this comparison of a wide range of documents and authors reveals is not a single Roman worldview, but a range of them, reflecting variations in cultural background, personal agenda, and political developments over time. Despite the common use of the itinerary to describe sequences of places, even in this category of material there is some circumstantial evidence for familiarity with cartographic images, either in informing the organization of the material or for facilitating its comprehension. Within the documentation emanating from generations of Roman clerks, there is clear evidence of sensitivity to the actual spatial relationships between places cataloged and to the physical geography of the real world in the organization of data, even if such sensitivity often becomes subservient to respecting hierarchies of status.

Despite the variations, some consistent features emerge. One is the acknowledged significance of the sea (specifically the Mediterranean and the outer ocean) as the chief reference point for many textual surveys of the Roman world (including the Antonine Itinerary), even though starting and ending points and directions of description might vary. The fortuitous positioning of Rome and Italy near the center of the *oikoumenē* surrounding the Mediterranean meant that Romans did not necessarily have to adjust their Greek models to satisfy their own sense of self importance. Moreover, long after the publication of Ptolemy's work with its more complete image of the *oikoumenē*, it is clear that the predominant model of the inhabited world onto which Romans mapped their understanding remained that inherited from Eratosthenes. Another consistent feature, despite varying preferences in orientation, is a noted tendency to describe space in an anticlockwise direction, regardless of whether the scope be as wide as the continents or much more limited. This tendency runs counter to expectations based on the direction of the shadow from a sundial's gnomon and, in combination with the northerly orientation of astronomy, on the direction of reading in Greek and Latin. Because it occurs already in the ordering of the rural voting tribes, there is the temptation to suggest that it is a tendency conditioned by the priority accorded to the tribes along the road to Rome's earliest colony at Ostia, as well as by a preference for describing the area to the south and east of the Tiber (traditionally Latin territory) before the area to the north and west of the river (traditionally Etruscan and hostile). For certain, such an anticlockwise perspective can be traced remarkably far back in the history of the Roman republic.

# NOTES

## ONE

1. Sources for Mesopotamian maps are reviewed in Röllig (1980–83). For a comprehensive discussion of building plans, see Heisel (1993), 7–75; Dolce (2000).

2. All dates are BCE.

3. Mellaart (1964), 55 and plates V–VI; Mellaart (1967), 176–77 and plates 59–60; Steward (1980).

4. For the study of ancient Mesopotamian toponyms, see Parpola (1970); *Tübinger Atlas des Vorderen Orients/Répertoire Géographique des Textes Cunéiformes*, Bd. 1–8 (Wiesbaden: Reichert, 1974–85).

5. Of course, the expression has reference only to the modern division of time into "hours," which did not apply in Near Eastern antiquity; the translation "double-hour" for *bēru* is, therefore, a concession to modern terms for ease of comprehension.

6. Reiner and Pingree (1981), 42:22–22a and 42:24b; discussion in Koch (1989), 119–32.

7. See ab.sínsi.ginx (GIM) ìi.dúr.dúr.re.eš.àm mul.an.zag.til.bi: *kīma šer'i sunnuqu kakkab šamê gimiršun*, "in order to keep all the stars of the sky in their prescribed course like the furrow [on a field]": *Textes cunéiformes du Louvre* 6 51 r.7f., see *Revue d'assyriologie et d'archéologie orientale* 11:145, line 29.

8. Heinrich and Seidl (1967); Baker (2004), 59. In Heisel (1993), see 8–19 and ills. M1–12 for the Early Dynastic and Akkadian periods; 23–24 and M15 for Ur III; 29–32 and M19–25 for Old Babylonian; 34–35 and M27–29 for Kassite; 40 and M32 for Neo-Babylonian; 50–51 and M42–43 for Achaemenid and Seleucid.

9. For example, Louvre AOT b.355 + 355 bis, on which see Heisel (1993), 13 and M2; Dolce (2000), 374n59 and fig.2, who draws attention to Sallaberger's analysis of the inscription on the reverse in which men, women and children are listed. Louvre fragment AOT b 357 belongs to the same context: see Thureau-Dangin (1897a), xxiv.64; Heisel (1993), 14 and M3.

10. For discussion of the interpretation of the measurements given, and the scale of the cubit (1:180), see Heisel (1993), 23; Dolce (2000), 376n67; and further, Robson

(1996).

11. King (1898–1900), pl. 242–43, BM 86349; see also Heinrich and Seidl (1967), 35–37.

12. The classification as a temple by Heisel (1993), 27–29, was corrected by Sallaberger, as Dolce (2000), 378nn83, 87, notes. The interpretation of PA.PAH (*papāhum*) as "reception room," is discussed by Kalla (1996), 251n10.

13. Louvre AOT b 356; see Heinrich and Seidl (1967), 27–29; Heisel (1993), 9–11 and M1.

14. Nippur 6 NT-428; Heinrich and Seidl (1967), 33–35; Heisel (1993), 25 and M16.

15. Examples include Nemet-Nejat (1982), nos. 3, 12, etc. See further Baker (2004), 61; Wiseman (1972), 145.

16. This is also suggested by the appearance of a house plan on the reverse of a Late Babylonian copy of part of the lexical series ur$^{5}$.ra; see Wiseman (1972), 145 and fig. 3 (BM 46740).

17. BM 132254; see Wiseman (1972), 145–46 and fig. 4; Heisel (1993), 39–40; Dolce (2000), 379 and fig. 11.

18. Hilprecht collection in Jena, HS 200a; see Oelsner (1984, 1989); Heisel (1993), 33–34 and M26; Sallaberger (2002).

19. Sallaberger (2002), 612–18, discusses the inscription.

20. Berlin, Vorderasiatisches Museum, VAT 8322 + 12886; see Jakob-Rost (1984).

21. BM 38217; see Wiseman (1972), 141–47; Heisel (1993), 42–44 and M35.

22. Statue B: see Edzard (1997), 30–38.

23. Sarzec (1884–1912) I, 138–40; II, vii–xv (copy), pl. 15, no. 1 (photo of plan), pls. 16–19 (photos of statue, all sides).

24. The "cubit" and stylus are also preserved on the inscribed Statue F, dedicated to the goddess Gatumdug. No ground plan is drawn on this statue, but it tells of the Ensi Gudea building the temple for Gatumdug on pure ground and giving her a throne and a treasure box; in return, Gatumdug guaranteed the health and productivity of livestock. See Edzard (1997), 46–48.

25. Edzard (1997), Cyl. A, 85 xxv 24-xxvi 14; Heimpel (1996), 17; cf. Dolce (2000), 368n21.

26. Paris, Louvre, AOT b 359, published by Thureau-Dangin (1897b); see Heisel (1993), 14 and M4; Dolce (2000), 373 and fig. 1.

27. For further discussion of Babylon's assumption of the place of religious capital city, and a new edition of Tablet I of Tintir = Babylon, see George (1997).

28. For a drawing, see http://www.schoyencollection.com/babylonianhist.htm (text MS 2063).

29. *CAD*, s.v. *ammatu*, discussion section.

30. *CAD*, s.v. *ammatu*, usages b–g.

31. For example, IM 53965; see Baqir (1951), problem 7.

32. King (1912), no. 8 i 26; also no. 7 i 14.

33. See Liverani (1990), 176n6, for a complete bibliography.

34. A technique described by Jöran Friberg as the "false area formula" is used for the computation of such irregularly shaped fields by several stages of approximations: see Friberg (1987–90), 542.

35. Stephens (1953), 1–2, figs. 1, 2.

36. The fragmentary tablet BM 73319, published in CT 22 49, may be identified as a city map of Nippur, assuming that the building in the center is Enlil's temple (bīt dEnlil); but it is oriented differently from the Nippur city map discussed in II.2.a below.

37. It is unclear whether the map fragment in Schroeder (1920), no. 25 (VAT 9423), is of Babylon. The text itself was found in Assur, but the Euphrates River is shown, which rules out the city of Assur.

38. A map showing the Euphrates and the Tabbištum canal may represent the city of Sippar: see CT 22 49 (BM 50644); Thureau-Dangin (1903) no. 154; Meissner (1920–25), 378.

39. Lenzen and Falkenstein (1956), 42, plate 23c.

40. See *CAD*, vol. 10, pt. 1, p. 315, s.v. “māru,” meaning 4 b for DUMU URU/*mār āli*.

41. See Sallaberger (1997); Lambert (1992); both are cited by George (1999), 83n49.

42. For the date and circumstances, see M. Gibson’s introduction to Zettler (1993), 4n6.

43. For cautionary remarks on the identification of Nippur’s “Small Shrine” with Kiur, see Zettler (1984), 238.

44. Electronic Text Corpus of Sumerian Literature, c.1.2.1, http://etcsl.orinst.ox.ac.uk/cgi-bin/etcsl.cgi?text-t.1.2.1#.

45. Borger (1956), 21, lines 47–51.

46. CT 22 49 (BM 35385). The city quarter called Tuba, on the right bank of the Euphrates, lay near another district called Kumaru/i, which may once have been a separate town that was later absorbed within the “metropolitan” area of Babylon. Both these districts, Tuba and Kumaru/i, came to be spelled the same way, with the logogram A.HA, by proximity; see Steinkeller (1980).

47. Tintir Tablet V: 101–2: see George (1992), 70; and 342–43 for further discussion of the mention of the Šamaš Gate in Tintir Tablet V: 56.

48. See Labat (1976), 166–67 (the KUR sign, meaning “hill”) and 236–37 (the A sign, meaning “water”).

49. Horowitz (1988); Finkel (1995).

50. Unger (1935), 318–22, which summarizes Unger (1931), 122–28.

51. Merodach-baladan in the Bible, Isaiah 39:1; 2 Kings 20:12; 2 Chronicles 20:31.

52. Asin, “Babylon, the place of creation of the great gods,” in George (1992), 68, lines 89–90.

53. Esarh. Prism A iii 25–52, in Potts (1982), 283.

54. Other kinds of stellar distances which are not so clearly systematic occur: see Horowitz (1998), 177–81.

55. Ptolemy *Almagest* 4.6.11, 5.14, 6.9, 9.7, 11.7. The Babylonian cubit is also used by Strabo (*Geography* 2.1.18).

56. For other terms for celestial “roads,” see Horowitz (1998), 257.

57. CT 26 45:11–15 (K. 2067); see George (1992), 366–67.

58. A photograph appears in al-Jadir (1987), 26–27.

59. See Brack-Bernsen (2005) for a discussion of the use of MUL.APIN for astronomical calculation, and for the idea that the MUL.APIN schemes constituted “methods of astronomical modeling of nature.”

60. MUL.APIN I iv 13–30; see further Hunger and Pingree (1989), 142, table IV.

61. O’Keefe (1993); O’Keefe and Nadel (1978); cf. Blaut (1991).

## TWO

1. Baines (1987), 277–305, 344–53.

2. Bierbrier (1982); Lesko (1994); Andreu and Barbotin (2002).

3. Harrell and Brown (1992), 95. For ancient Egyptian cartography in general, see Shore (1987).

4. For Tell el Amarna, see Kemp (1989), chap. 7; on its administrative zone, Pendlebury (1951), especially chap. 7; on the Amarna Letters, Moran (1992).

5. Lichtheim (2006b), 57–72; Gardiner (1960); for a commentary, Kitchen (1982), 50–64, and for depictions 55 (fig. 18), 57 (fig. 19), 58 (fig. 20b); more completely, Heinz (2001), 281–303.

6. Heinz (2001), 293 lower left.

7. On Punt, see most recently Kitchen (2005); for the representation of Punt and the sea route thereto, see W. Smith (1965), 137–39.

8. Redford (1982); (1992), 92, 143.

9. Turin Papyri nos. 1879, 1899, 1969; see the bibliographies cited by Harrell and Brown (1992).

10. Harrell and Brown’s choice of term. An alternative is the “mine-map” of Turin

(Janssen 1994, 91), but, as Harrell and Brown point out, the gold mines referred to on the papyrus complement its main purpose, rather than forming the center of interest.

11. For this identification, see Harrell and Brown (1992), 100–3; they are supported by a leading expert on Deir el Medina, Janssen (1994), 96n31. On Amennakhte, see B. Davies (1999), 105–18, and in index s.v. “Amennakht (V).”

12. Turin Papyrus 1885.

13. Harrell and Brown (1992), 85n14.

14. Another location, not far away from Bir Umm Fawakhir, is proposed by Klemm and Klemm (1988).

15. Omlin (1973), 27 and Blatt XII.

16. Harrell and Brown (1992), 86: “a beautiful grayish-green sculptural stone (chloritic sandstones and siltstones).”

17. Klemm and Klemm (1993), 355–76.

18. Klemm and Klemm (1988) prefer a different location.

19. Note again Redford’s theory (1982) that the toponym lists described above incorporated itineraries: in more maplike formats for these, approximate time-distances from one point to another would have been useful additions.

20. Note that the two men—Neferhotep and Amenhotep—identified as possible firsthand sources of information for Amennakhte were probably not inhabitants of Deir el Medina and thus not likely sources: Janssen (1994), 96n31.

21. Almost nothing is known about the range of topics and artwork that might have been included in a royal archive.

22. Bryan and Kozloff (1992), 137, fig. V.17; Hawass (2003), 160–63.

23. To display on the ground a papyrus so strongly associated with divinities (Tait 2003, 187) would seem disrespectful according to Egyptian concepts of decorum. The idea that it might have been displayed extended across a wall face is based on a suggestion about another papyrus altogether (P. Harris, over 40 m long); Tait (2003, 188) notes: “There is . . . no direct evidence for such an exhibition of a papyrus scroll, and the colored illustrations [on P. Harris] seem too well preserved to have been exposed to daylight in antiquity.”

24. For an introduction, Ashmore and Knapp (1999); see also especially Crumley (1999); van Dommelen (1999).

25. See, for example, Richards (1999); also O'Connor (2005); Dorman and Bryan (2007).

26. For an old but useful introduction, Kees (1961), chap. 8; see also Baines and Malek (2000), 18, 131.

27. Birket Qarun in Arabic; called Moeris by the Greeks, but by the Egyptians (since ca. 1550 BCE) "the sea" or *p3 ym*, whence is derived the modern word Fayum, via Coptic Peiom. See Beinlich (1991), 285.

28. Beinlich (1991), 27–66; Tait (2003), 183–84.

29. One copy, for example, was written in the reign of the emperor Hadrian (117–138 CE).

30. Unusually, the "Book of the Fayum" is designed to be read, or at least viewed, from left to right; normally, Egyptian texts on papyrus were laid out to be read in the opposite direction.

31. See especially Beinlich (1991), 79–80, with regard to the place "Pyramid land is its name" as modern Hawara.

32. Tait (2003, 192) describes this section somewhat differently as a "representation of the Fayum as a whole," rendered as "a long rectangle, presumably showing the Fayum as raised, cultivable land," but the narrower view taken by Beinlich fits the particularization evident in the succeeding sections.

33. In Beinlich's view (1991, 92) as mentioned above, section 3 of the book depicts the lake as set within, and thus equivalent to, the framework or outline of a temple.

34. Ashmore and Knapp (1999), 16–18. For an instructive instance, note the situation regarding the ancient Maya, who, at "a variety of scales, from household to civic center and perhaps beyond . . . referred to and replicated the key elements of an ideational landscape: mountains of earth and stone, water lying within the earth, and caves linking them all together. Leaders of family and polity alike took hold of the critical anchoring complex, and created domestic, public, and mythical landscapes in which the continuities of human existence were verified by material reference to primordial landscape assemblages" (Brody and Ashmore 1999, 139).

35. Clagett (1995); Bryan (1997) for a three-dimensional sky map.

36. Hornung (1990); Quirke (2003); Robinson (2003).

37. See further chap. 5 below.

## THREE

1. Known from Diogenes Laertius, *Lives of the Philosophers* 5.51.

2. Newmeyer (1983); Romm (1992), 64–68.

3. Herodotus 4.44; Panchenko (1998, 2003). Scylax of Caryanda (fl. ca. 510–500), a Greek commissioned by the Persian Great King Darius I (522–486) to explore the Indus river basin, "proved" that Asia, like "Libya" (Africa), was almost completely circumnavigable.

4. Interpretation of a coin reverse from Ionia (ca. 335) as a topographic map of the hinterland of Ephesus fails to convince: see Johnston (1967); Dilke (1988), 92; Brodersen (2001), 10. Equally, both the authenticity and the scope of an unfinished map (perhaps of Spain) associated with a fragment of the *Geographoumena* of Artemidorus of Ephesus (ca. 100) are matters of ongoing debate: see now Brodersen and Elsner (2009), esp. 63–71. The "Soleto map" of Italy's Sallentine Peninsula in the fifth century is surely a hoax: see Yntema (2006).

5. At Thoricus in southeast Attica there survives on the rock face immediately above the entrance to silver mine 3 (fourth century) a petroglyph which appears to be a plan of the mine corresponding to the 120 m section thus far excavated: see Mussche (1978), 44, 48, fig. 53.

6. See Jacob (1998), 30–36; Dueck (2005).

7. Harley and Woodward (1987), 106.

8. Pliny, *Natural History* 6.61.4.

9. See the maps in Willcock (1976), 24, 28, 36.

10. *Odyssey* 10.506–15; the translation of this passage, and those below, is by Lattimore (1965).

11. See Hexter (1993), 147. Homer's view fails to explain seasonal changes in the length of daylight.

12. Severin (1987), 235–45, concludes that Homer neither thought in cartographic terms nor even had maps.

13. Neugebauer (1963), 529–30, 533.

14. Strabo 1.1.11; Hahn (2001), 202–3.

15. Kirk, Raven, and Schofield (1983), 104; Harley and Woodward (1987), 134.

16. Couprie, Hahn, and Naddaf (2003), 32, 49.

17. Diogenes Laertius, *Lives of the Philosophers* 2.1–2; Agathemerus 1.1 (for him, and other Greek scientists discussed in this chapter, see further Keyser and Irby-Massie 2008, s.v.).

18. Couprie, Hahn, and Naddaf (2003), 49.

19. For an overview of the debate about Anaximander's map and its features, see Couprie, Hahn, and Naddaf (2003), 194–201.

20. Hippolytus, *Refutation of all Heresies* 1.6.4–5; Aetius 2.20.1, 2.21.1; O'Brien (1967), 425–26.

21. Couprie, Hahn, and Naddaf (2003), 82–83. Full-scale architectural plans (made around 250 BCE) appear to be etched into the walls of the temple of Apollo at Didyma, south of Miletus: see Haselberger (1985), 129.

22. Agathemerus 1.1, 2.461; cf. Strabo 1.1.1.

23. Couprie, Hahn, and Naddaf (2003), 33.

24. No doubt the map marked the route of the Persian Royal Road, which Herodotus (5.52–54) proceeded to describe in some detail, stating the short distances between staging posts in both Persian *parasangs* and Greek *stadia*; see Silverstein (2007), 9–15.

25. See further Dewald and Marincola 2006.

26. Diogenes Laertius, *Lives of the Philosophers* 9.46, where the title given, *Kosmographie*, emphasizes the orderly arrangement of the universe and the earth.

27. Pseudo-Plutarch, *Epitome* 3.10.4–5, 3.12.1–2; Taylor (1999), 100–2.

28. Strabo 1.1; Agathemerus 1.2 and 12; Dilke (1985), 25, 29.

29. Aristotle, *On the Sky* 285b25–27, 293b25–30.

30. Plato, *Timaeus* 31b4–34b9; Dicks (1970), 72–73; Dilke (1985), 25.

31. Strabo 2.2.1–2; Plutarch, *On the Opinions of the Philosophers* 2.12, 3.14 attributes the division to Pythagoras.

32. *On the Sky* 297a8–298a20.

33. *Introduction to Phaenomena* 16.4.5.

34. Barber (1935), 26–29, 175–76.

35. Pearson (1960), 22–49, 83–114; Pédech (1984), 15–158.

36. Strabo 2.4.1–2. For translation and discussion of the fragments of Pytheas, note Roseman (1994); Bianchetti (1998); Roller (2006), chap. 4.

37. Strabo 1.4.3; 2.4.1–2.

38. Strabo 2.1.18; he assumes that the measurement was taken on or near the same parallel as the Bactrians near the Caucasus.

39. Strabo 2.4.1, 2.5.8 and 43.

40. Hipparchus, *Commentary on the Phaenomena of Aratus and Eudoxus* 1.4.1; Dicks (1960), 171.

41. Strabo 2.4.2. Dicaearchus's estimate of the earth's circumference, derived from data reported by Cleomedes 1.8, adds up to 300,000 *stadia*: see Keyser 2001.

42. Cleomedes 1.10.3–4; Dutka (1993–94), 60–64; Irby-Massie and Keyser (2002), 120–21.

43. Strabo 2.5.6; Dueck (2005), 28, 45–46.

44. Strabo 2.5.16; Cimino (1982); Geus (2004), 19.

45. Geus (2004), 21; Strabo 2.1.21–24.

46. Eratosthenes himself was aware that his measurements were approximations at best: Strabo 2.77–78, 80–82, 86, 89, 91–92. Strabo, in turn, who had little tolerance for mathematics, considered Hipparchus's criticisms unfair and unreasonable: cf. 3.131–32.

47. Dicks (1960), 32, 114–21.

48. Strabo 1.4.1, 2.5.34, 3.131–32; Duke (2001–2).

49. Strabo 1.4.6. To determine the circumference of any parallel or meridian of a sphere, one must first determine the radius at a given latitude and longitude, by multiplying the cosine of the latitude angle by the radius at the equator (for Eratosthenes's earth: 40,127 *stadia*). Then, the circumference at that latitude is $2\pi$ times the latitude radius. Although the Greeks lacked sines and cosines, a table of chords prepared by Hipparchus served the same function (Theon, *Commentary on Ptolemy's Syntaxis* 1.10).

50. Strabo 2.1.34, 2.1.27.

51. Dicks (1960), 35; Strabo 2.92, on promontories in the Peloponnese, Italy, and Liguria.

## FOUR

1. The chief weakness of Ptolemy's scheme is its susceptibility to errors arising from miscopying of the text. Such errors affect the maps mostly at the level of fine details.

2. For a general account of his life and work, see Toomer (1975), updated by Jones (2008).

3. The specific works alluded to are, respectively, the *Harmonics*, the *Optics*, and the *Tetrabiblos*.

4. Splendidly translated by Toomer (1984).

5. The broadest study of Ptolemy as a philosopher remains Boll (1894).

6. For English translations of these works, see, respectively, Barker (1989); A. Smith (1996); and Liverpool-Manchester Seminar (1989).

7. The scheme is described in a part of book 1 of Ptolemy's *Planetary Hypotheses* that survives only in Arabic translation; see Goldstein (1967), 6–7.

8. See *On the Kriterion*, sec. 15, and introductory secs. 1–8 of bk. 2 of the *Planetary*

*Hypotheses*. The latter survives only in Arabic translation; for the only available modern-language version (in German), see Nix (1907).

9. For the rejection of Aristotle's fifth-element cosmology, see Falcon (2001).

10. *Harmonics*, bk. 1, chap. 1, gives a lucid statement of this recursive strategy.

11. For the parts of the *Geography* referred to from here on, see Berggren and Jones (2000). The original Greek is now best consulted in Stückelberger and Graßhoff (2006).

12. Geus (2002), 261–63.

13. See further in this connection chaps. 6 and 7 below.

## FIVE

1. For the former, see chap. 1 above.

2. This was first realized, it is said, by Thales of Miletus, the pioneer Greek geometer of the sixth century BCE (Kirk, Raven, and Schofield 1983, 76–86); but significantly he made the discovery in Egypt, and no doubt he learned it from Egyptians.

3. Edwards (1985), 99, 246–47.

4. Hero, *Dioptra*, ed. Schöne (1903); Africanus, *Cesti*, ed. Vieillefond (1970); Anonymus Byzantinus, *Geodesy*, ed. Vincent (1858); al-Karaji, *Inbat al-miyah al-khafiyya* (1940). All relevant passages are translated into English in Lewis (2001), 259–302.

5. For an overview, see Dilke (1971).

6. See, respectively, Dilke (1987a), 220–25; chap. 6 below; and Frontinus, *Aqueducts* 17.

7. The least unsatisfactory of earlier accounts are Kiely (1947) and (though brief) Adam (1994), 8–19.

8. Vitruvius, *On Architecture* 8.5.

9. For discussion, Lewis (2001), 82–89.

10. See above, chap. 2, sec. V.

11. The design and evolution of the dioptra are explored in Lewis (2001), 71–82, 101–5.

12. Hero, *Dioptra* (Schöne 1903), 25, 7, and 10 respectively.

13. Rodriguez Almeida (1981), 45–48, 52n1.

14. The manuals give several procedures for measuring river widths. This is the one described by Marcus Iunius Nypsus, *Fluminis varatio* (ed. Bouma 1993), 4–28.

15. For fuller detail, Lewis (2001), 89–97.

16. On aqueduct gradients and instrumental accuracy, see Lewis (2001), 172–78.

17. Africanus, *Cesti* (Vieillefond 1970), 1.15.2; Hero, *Dioptra* (Schöne 1903), 12.

18. The complex material is collected in Lewis (2001), 157–66.

19. Talbert (2000) (= *BAtlas*), 58D2.

20. Cited by Strabo, *Geography* 1.3.11. For further details see Lewis (2001), 168–70.

21. See above, chap. 3, under "Challenges to the Study of Greek Cartography."

22. Scholiast on Ptolemy, *Geography* 1.3.3; John Philoponus, *Commentary on the First Book of Aristotle's Meteorology* (ed. Hayduck 1901), 15.5–8; Simplicius, *Commentary on Aristotle's De Caelo* (ed. Heiberg 1904), 548.27–549.10.

23. See further chaps. 6 below and 4 above.

24. Vitruvius 10.9. See further Sleeswyk (1979, 1981); Lewis (2001), 134–39.

25. See more fully Schiöler(1994).

26. For text, translation and commentary of most of the component manuals, Campbell (2000).

27. See, for example, *BAtlas* 32–33, 39–42, 44–45; note also Clavel-Lévêque et al. (1998, 2002).

28. H. Davies (1998), 4. On this complex and contentious subject see Lewis (2001), 217–45.

29. The gradients of the aqueducts of Rome are not adequately recorded: see Ashby (1935); Blackman (1978).

30. For Roman aqueducts in general, see Hodge (1992), an invaluable treatment which supplies much of the practical detail given in what follows here.

31. Faventinus, *On the Diverse Skills of Architecture* (ed. Plommer 1973), 6.

32. Ibn al-'Awwam, *Kitab al-Filaha* [Book of Agriculture] (trans. Clément-Mullet 1864), 1.131.

33. This whole matter is argued more fully in Lewis (1999).

34. Hodge (1992), 184–91; and Hauck (1988), 74–82 (a semifictional but insightful account of the building of the Nîmes aqueduct).

35. Fabre, Fiches, and Paillet (1991) is an admirable and exhaustive study; see also Lewis (2001), 181–93.

36. Crow, Bardill, and Bayliss (2008), 1; in *BAtlas* 52B2–D2 this line should extend further, to 6 km west of Bizye (B1).

37. Much the most authoritative (and splendidly illustrated) overview of ancient tunnels is Grewe (1998); many of the details in what follows are drawn from it. See also Oleson (2008), 319–33 (a chapter written by Grewe).

## SIX

1. For a concise overview see, for example, Bispham (2008), 51–55, 62–65, 93.

2. Beard (2007), 143–86.

3. The description is by Livy (41.28), a historian active around the end of the first century BCE.

4. Varro, *De Re Rustica*.

5. The phrase is that of Pliny the Elder, *Natural History* 3.17, written around 70 CE. The limited surviving testimony for Agrippa's work is gathered by Riese (1878), 1–8, and analyzed by Arnaud (2007–8). For the portico, see Steinby (1999), 151–53, s.v. "Porticus Vipsania."

6. Brodersen (2003), 268–87, supported by Carey (2003), 41–74. For Augustus's record and its presentation, see Cooley (2009), 6–22.

7. Note the opening chapter of Polybius, *Histories*, and discussion by Shahar (2004), 169–89.

8. On these claims, see *Res Gestae* 31–33, with commentary by Cooley (2009), 249–56.

9. Hyde Minor (1999).

10. *Anthologia Palatina* 9.778 (Philip of Thessalonica); Smallwood (1967), no. 369, esp. col. II, line 27.

11. *Panegyrici Latini* 9(4).20.2.-21.3 (Mynors); my translation is based on Nixon and Rodgers (1994), 171–77.

12. Stanford Digital Forma Urbis Romae Project (http://formaurbis.stanford.edu); see further Trimble (2007).

13. This orientation was evidently the norm for presenting and viewing Rome: see further chap. 7 below.

14. Inevitably, lack of space precludes the elaboration of potentially controversial claims in what follows; for further details and discussion, see now Talbert (2010).

15. Thomson (1961), xlvii, summarizing the view of "the crazy-looking construction" which he had expressed earlier in Thomson (1948), 379.

16. Brodersen (2003), 63, 187, with Garland (1994).

17. Talbert (2010), 108–17.

18. Giacchero (1974), 134 (lines 16–26), with Rees (2004), 139.

19. Duval (1987), 474, 476.

20. See now Canepa (2009), 84–99.

21. Giacchero (1974), 137 (lines 148–50).

22. Aillagon (2008), 86–91, 611–13 (by C. Panella).

23. Wilkes (1993), 60, 62, 72–73 with fig. 4. The hall measures 32 by 14 m, and the arc of the apse 12.1 m.

24. Woodward (2007), 1598 (by P. Barber).

25. Talbert (2012), 243–46.

26. Talbert (2007), 269–70.

27. The standard edition is Schnetz (1940); see further Talbert (2010), 164–66.

28. In his indispensable edition, Westrem (2001) takes the Antonine Itinerary to be the source of many of its names; but some, if not all, of these could equally well have been transmitted through maps. For the map's position in the cathedral and its viewing, note Terkla (2004).

29. See, for example, Gautier Dalché (2008) and Lozovsky (2008).

30. Gautier Dalché (2004); Talbert (2010), 166–72.

## SEVEN

1. See, for example, Bekker-Nielsen (1988); Brodersen (2001, 2003); Whittaker (2002).

2. The concept was applied to the Greco-Roman world by Janni (1984); for Rome specifically, see Rawson (1985), 259.

3. For discussion, see Lee (1993), 81–90; Mattern (1999), 24–80; Sidebottom (2007); Talbert (2008).

4. The method is applied to later material by Gautier Dalché (1991).

5. Sallmann (1971); Nicolet (1988, 1991).

6. For collections of various categories of materials derived from the medieval manuscript tradition, see Müller (1855–61); Riese (1878); Cuntz (1929); Schnetz (1940); Glorie et al. (1965).

7. Scott (2002); for Latin Christendom in late antiquity, Lozovsky (2000); Merrills (2005).

8. See, for example, Pretzler (2007).

9. See, for example, Clarke (1997); Dueck (2000).

10. Text in Müller (1855–61), vol. 2, 103–76; Tsavarē (1990); English translation in Greaves (1985).

11. The most accessible edition of both remains Riese (1878), although Schnabel (1935) is superior; Brodersen (1996), 329–66, offers a text and German translation. For the argument that these works preserve captions to maps, see Riese (1878), xvii.

12. The *Demensuratio* comprises 30 captions: [Asia, 7] India, Media, Mesopotamia, Babylon, Taurus, Armenia, Insulae; [Europe, 17] Dacia, Sarmatia, Creta, Macedonia, Epirus, Sicilia, Italia (peninsular), Italia (northern), Corsica, Sardinia, Illyricum, Germania, Gallia Comata, Gallia Narbonensis, Hispania citerior, Asturia-Gallaecia-Lusitania, Hispania ulterior; [Africa, 5] Gaetulia and Mauretania, Africa Carthaginiensis, Africa Cyrenaica, Aegyptus, Arabia-Aethiopia; [trans Oceanum, 1] Britannia. The *Divisio* comprises 25: [Overview, 1] Europe-Asia-Libya; [Europe, 13] Hispaniae tres, Baetica, Lusitania, Citerior, Gallia Comata with Britannia, Narbonensis, Italia, Raetia, Germania, Epirus-Achaia-Attica-Thessalia, Macedonia-Thracia-Hellespontus, Dacia, Sarmatia-Scythia-Taurica; [Asia, 9] Asia citerior, Asia superior, Armenia, Syria, Aegyptus, Arabia Eudaemon, Mesopotamia, Media-Parthia, India; [Africa, 2] Carthaginiensis, Gaetulia and Mauretania.

13. Gautier Dalché (2008).

14. Arnaud (1989); Salway (2004), 92–95.

15. On late republican geography and ethnography see Rawson (1985), 250–66; Vasaly (1993).

16. *De nuptiis Philologiae et Mercurii* 6; Stahl, Johnson, and Burge (1977) for English translation.

17. *Institutiones* 2; *Saeculares litterae* 6; Vessey and Halporn (2004) for English translation.

18. Rawson (1978), 31 = (1991), 348; Paniagua Aguilar (2006), 37–79 (*agrimensura*), 149–94 (geography).

19. *Institutiones* 1; *Divinae lectiones* 25.2.

20. His description of Rome as “home of the rulers” (οἶκον ἀνάκτων, 335) sits more

comfortably in the mouth of a subject than a citizen. He is identified as a resident of Alexandria and as writing under Hadrian by acrostics at lines 112–34 and 513–32.

21. Texts in Müller (1855–61), vol. 2, 177–89 (Avienus), 190–99 (Priscian).

22. Edition with French translation: Arnaud-Lindet (1993).

23. Edition with English translation: Liddle (2003).

24. Freeman-Grenville et al. (2003); Notley and Safrai (2005).

25. Billerbeck et al. (2006–).

26. Nicolet (1991), 175–78.

27. Reynolds (1989), 265–318. The water transport chapters (nos. 35, 35A [= 69, 70 in the revised numeration of the forthcoming edition of Michael H. Crawford et al.]) appear at 303–5, 306–11.

28. Corcoran (2000), 206, 224–25.

29. Arnaud (2007), 323.

30. Seeck (1876); Rees (2004), 160–70, for partial English translation. See further Jones (1964), appendix 2, vol. 3, 347–80; Brennan (1996); Kulikowski (2000).

31. Discussion by Jones (1964), vol. 1, 712; vol. 3, 225 n. 2. Editions: Seeck (1876), 261–74; Mommsen (1892), 552–612; Glorie et al. (1965), vol. 2, 379–406.

32. 1–5: *comes Orientis, proconsul Asiae, comes Phrygiae Pacatianae, comes Galatiae I, vicarius Longi Muri*; 6–33: *consulares Palestinae I, Palestinae II, Phoenicae maritimae, Syriae II, Theodoriadis, Osrhoenae, Ciliciae I, Cypri, Pamphyliae, Bithyniae, Hellesponti, Lydiae, Phrygiae Salutaris, Pisidiae, Lycaoniae, Novae Iustinianae, Armeniae II, Armeniae Maioris, Cappadociae I, Cappadociae II, Helenoponti, Europae, Thraciae, Rhodopae, Haemimonti, Cariae, Lyciae, Augustamnicae I*; 34–48: *praesides/correctores Libyae Superioris, Aegypti I, Aegypti II, Augustamnicae II, Palestinae III, Arabiae, Euphratensis, Mesopotamiae, Ciliciae II, Armeniae I, Galatiae II, Honoriadis, Insularum, Moesiae II, Scythiae*. Libya Inferior, Thebais I and II, and Arcadia are missing, perhaps having dropped out in the last section between Libya Superior and Aegyptus I. On the context, see Kelly (2004), 158–65.

33. Mommsen (1892), 511–51, at 535–42.

34. Dilke (1987b); cf. Bekker-Nielsen (1988); Brodersen (2001), 44–65; Whittaker

(2002), 99–103.

35. Delano-Smith (2007).

36. Salway (2004); Arnaud (2005).

37. Edition with English translation: Casson (1989). Note further Menippus's *periplus* of the "Inner Sea" (i.e., the Mediterranean and Black Sea coasts) of ca. 30 BCE, preserved largely only in an epitome by Marcianus of Heraclea; also the anonymous *Stadiasmus* of the "Great Sea" (i.e., the Mediterranean) of the Augustan age. Both appear in Müller (1855–61), vol. 1, 563–73, 427–514; for a more modern critical edition of the *Stadiasmus*, see Bauer and Helm (1955), sec. 4.9 (§§240–613), 43–69.

38. *Rylands Papyri* 628 recto and 638 [= 628 verso] carry drafts of the itineraries, which are partially incorporated into the fair copy of the accounts on 627 verso. See Matthews (2006), 56–61, for partial English translations.

39. Text in Cuntz (1929), 86–102; Glorie et al. (1965), vol. 1, 1–26.

40. Elsner (2000); Hunt (2004); Salway (2007), 188–90, 205–9; Salway (2012).

41. *Corpus Inscriptionum Latinarum* (= *CIL*) XI 3281 (15.3 cm high × 7.7 cm diameter), 3282 (14 × 7.3–7.0 cm), 3283 (2.3 × 6.3–6.2 cm), and 3284 (9.5 × 6.8–6.5 cm); Chevallier (1976), 47–50.

42. *CIL* XIII 9158 = XVII/2 675. See further Salway (2007), 192–94.

43. Sundwall (1996), 631–40.

44. Text in Cuntz (1929), 1–85; note also the study by Löhberg (2006). On the nature of the text and its authorship, see Arnaud (1993); Talbert (2007).

45. Structure of the Antonine Itineraries: I, Africa-Egypt (1.1); II, Sardinia (78.4); III, Corsica (85.4); IV, Sicily (86.2); V, Italy-Egypt (98.2); VI, Thrace (175.1); VII, Cappadocia-Syria (176.3); VIII, Moesia-Bithynia (217.5); IX, Pannonia-Gaul (231.8); X, Pannonia-Germany (241.1–2); XI, Raetia-Asia (256.4); XII, Dalmatia-Macedonia (337.3); XIII, Italy-Germany (339.6); XIV, Italy-Spain (387.4); XV, Britain (463.3).

46. *Supplementum Epigraphicum Graecum* (= *SEG*) 51 (2001) 1832 = *L'Année Epigraphique* (= *AE*) (2001) 1931, faces B (left) and C (right). For full publication, see Şahin (2007), 22–41.

47. For the detail of this analysis, see Salway (2007), 194–201.

48. Although given in stades, 83.9% of the distances are rounded to whole or half miles: Salway (2007), 201–2.

49. Hopkins (1983), 102–5; Corcoran (2000), 224–25.

50. Arnaud (2007), 331–36.

51. Mastino (1986); Nicolet (1991), 15–56; Dench (2005), 59–60, 217–21.

52. See Cooley (2009), 102–4.

53. *SEG* 51 (2001) 1832 = *AE* 2001, 1931, face B, lines 3–4: ὁ τῆς οἰκουμ[ένης α]ὐτοκρά|τωρ.

54. Rajak (1991); Shahar (2004), 256–59.

55. Aelius Aristides, *To Rome*, 61–62, 80–81; for edition and English translation, see Oliver (1953).

56. *Expositio totius mundi et gentium* 45.1: Cappadocia is described as *media terrena*.

57. *Berliner griechische Urkunden* II 628r = *Chartae Latinae Antiquiores* X 415, col. II, lines 4–6. In later legislation, note *provinciae transmarinae* in 372 (*Codex Theodosianus* 6.14.1) and *transalpinae ecclesiae* in 445 (Valentinian III, *Novel* 17.1.pr.).

58. See further Salway (2008), 72–77 (with fig. 3.1).

59. Only around 300 CE was it used to designate the very tip of the continent, when this region was made a province separate from Thrace.

60. *Inscriptions grecques et latines de la Syrie* III I.718; see most recently Raggi (2004).

61. See further Merrills (2005), 35–99, with a translation of Orosius's entire geographic preface at appendix A, 313–20.

62. Edson (2008), 222–25. Isidore's encyclopaedia is translated by Barney et al. (2006).

63. On proportions in the T-O and *mappa mundi* tradition, see Harvey (1991), 19–24; Bremner (2006), 220.

64. E.g., Isidore, *Etym.* 14.3 (*de Asia*), 14.4 (*de Europa*), 14.5 (*de Libya*); trans. Barney et al. (2006), 285–93. The same order is found also in Josephus, *Bell. Iud.* 2.365–89 (16.4), the body of Ampelius sec. 6 (cf. the introduction to the same section, which has the order Asia, Africa, Europe), and the *Demensuratio provinciarum*.

65. In his edition and English translation Vassiliev (1936), 36, dates this work to 350. Rougé (1966), 9–26, prefers 359/60; Barnes (1993), 311n7, between 347 and 350.

66. A *periplus* by Artemidorus of Ephesus (ca. 100 BCE), however, took the continents in the order Europe, Africa, Asia, or so its epitome by Marcianus of Heraclea indicates; Müller (1855–61), vol. 1, 574–76.

67. Books 1–2, general introduction; (Europe) 3, Spain; 4, Gaul and Britain; 5–6, Italy and Sicily; 7, Central Europe, Cisdanubian areas, Epirus, Macedonia, Thrace; 8–10, Peloponnese, central Greece, islands; (Asia) 11, Caucasus, Parthia, Media, Armenia; 12–14, Asia Minor; 15, India, Persia; 16, Mesopotamia, Syria, Judaea; (Africa) 17, Egypt, Libya. See further Clarke (1999), 194–95.

68. Mommsen (1895); an English translation by Frank E. Romer is in preparation.

69. 18.1: *mediterranea maria*; *mediterranea litora*; 23.13: *mediterraneis sinibus*.

70. Text: Berry (1997); English translations: ibid.; Romer (1998).

71. Menippus started at the Bosphorus, the *Stadiasmus Maris Magni* and Dionysius, *Periegesis*, both at Alexandria. See further Salway (2004), 53–67.

72. See Stückelberger (2004), 32.

73. See Scafi (2006). This orientation follows Old Testament precedent: Janowski (2007), 54–56.

74. *Hispania superior* (coupled, but not necessarily contrasted, with *citerior*) in an inscription of 7 September 227 CE may represent an exception, but the evidence is ambiguous: see Alföldy (2000).

75. Edition: Barnes (1982), 202–3; translation: Rees (2004), 171–73; dating: Barnes (1996), 548–50; Zuckerman (2002), 620–28, 636–37.

76. Nicolet (1991), 195–97, with fig. 54.

77. Thomsen (1947), 15–144; Nicolet (1991), 203.

78. Campbell (2000), 78–79.

79. *CIL* V 7749 = $I^2$ 584 = *Inscriptiones Latinae Liberae Reipublicae* 517.

80. *AE* 1919.10 = *SEG* I 329 = XXIV 1109 = *Inscripţiile din Scythia Minor* I 68 (c. 100 CE), lines 1–8: ὁροθεσία Λαβερίου Μαξίμου ὑ[πατικοῦ]| fines Histrianorum hos esse con[stitui - - - Pe]|lucem laccum Halmyridem a do[minio - - -]| Argamensium, inde iugo summo [- - - ad c|o]nfluentes rivorum Picusculi et Ga[brani, inde ab im|o] Gabrano ad capud eiusdem, inde [- - - iuxta rivum | S]anpaeum, inde ad rivum Turgicu[lum - - -]| a rivo Calabaeo, milia passum circi[ter D?XVI]. See Oliver (1965); and, for this category of document, Burton (2000), 195–215.

81. *AE* 1989, 681; *SEG* 39 (1989) 1180; Cottier et al. (2008).

82. Nicolet (1994).

83. Plin. *NH* 3.37; Christol (1994), 47–50.

84. *CIL* VI 3492 = *ILS* (= *Inscriptiones Latinae Selectae*) 2288 = *AE* 1994, 37 and 1995, 44; English translation: Campbell (1994), 84–85; see further Cosme (1994), 172–73.

85. Their creation had been relatively recent; they are to be distinguished from the dioceses (Latin *conventus*) into which some provinces had been subdivided much earlier. For a survey of territorial divisions between 285 and 337, see Barnes (1982), 195–200.

86. Thus, in 314–316 CE, *CIL* III 13734 = *ILS* 8938 = *AE* 1984, 111 from Tropaeum Traiani, Scythia names Constantine ahead of Licinius; for the latter's earlier precedence, note *CIL* III 6174 and 14215.2 (both from Scythia); *AE* 1924, 94 (from Thrace).

87. Cf. Shahar (2004), 258, who implies that the organization is to some extent hierarchical, the commencement of the description with Achaea, Macedonia, and Asia reflecting their status as consular provinces.

88. *Bell. Iud.* 2.365–89 (16.4): Greece and Macedonia (365); Asia and Pontus (366–67); Bithynia, Cappadocia, Pamphylia, Lycia, Cilicia, Thrace (368); Illyrians, i.e., Moesia and Pannonia (369); Dalmatia (370); Gaul (371–73); Spain and Lusitania (374–75); Germany (376–77); Britain (378); Parthia (379); Carthaginians, i.e., Africa (380); Cyrenaica, Numidia, and Mauretania (381); Egypt (384–85).

89. *AE* 1981, 777; English translation: Campbell (1994), 240; see further Lebreton (2009), 15–20 (with figs. 1–2) and 48–49.

90. Eadie (1967); Arnaud-Lindet (1994).

91. *Brev*. 4.1–2, Sicily, Sardinia, Corsica; 4.2–5, Africa; 5, Spain; 6, Gaul and Britain; 7–8, Illyricum; 9, Thrace; 10, Asia and the islands (Asiana); 11, inland Anatolia (Pontica); 12, Cilicia, Isauria, Syria; 13, Cyprus, Cyrene, Egypt; 14, Armenia, Mesopotamia, Arabia; 15–30, history of Roman-Persian wars from Pompey to present.

92. Honigmann (1939). The text seems to have originated in the mid- to late fifth century and been haphazardly updated into the reign of Justinian; see Jones (1971), apps. 3 and 4, 502–40.

93. Feissel (1991), 448–53.

94. The order of the *Synekdēmos*: (Oriens: Thracica, 1–6) Europa, Rhodope, Thracia, Haemimontus, Moesia II, Scythia; (Illyricum: Macedoniae, 7–13) Macedonia I, Macedonia II, Thessalia, Hellas, Creta, Epirus Vetus, Epirus Nova; (Daciae, 14–19) Dacia Mediterranea, Dacia Ripensis, Dardania, Praevalitana, Moesia I, Pannonia; (Oriens: Asiana, 20–30) Asia, Hellespontus, Phrygia Pacatiana, Lydia, Pisidia, Lycaonia, Phrygia Salutaris, Pamphylia, Lycia, Insulae, Caria; (Pontica, 31–41) Bithynia, Honorias, Paphlagonia, Galatia I, Galatia Salutaris, Cappadocia I, Cappadocia II, Helenopontos, Pontos Polemoniacus, Armenia I, Armenia II; (Oriens, 42–56) Cilicia I, Cilicia II, Cyprus, Isauria, Syria I, Syria II, Euphratensis, Osrhoene, Mesopotamia, Phoenice, Phoenice Libanensis, Palaestina I, Palaestina II, Palaestina III, Arabia; (Aegyptiaca, 57–64) Aegyptus, Augustamnica I, Augustamnica II, Arcadia, Thebais I, Thebais II, Libya Superior, Libya Inferior.

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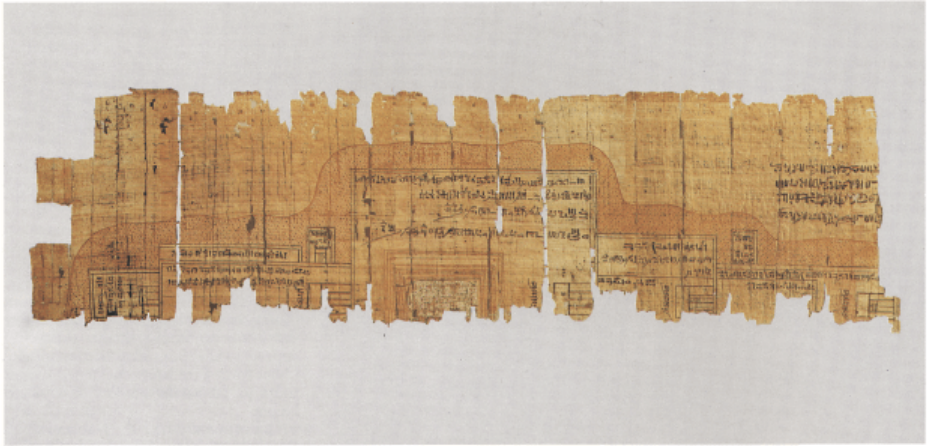
# PLATES SECTION

PLATE 1a Part of a representation of a town in a Neolithic wall painting from Çatal Hüyük, Turkey, dated to the early seventh millennium BCE. Approximately 3 m in length. Image reproduced from J. Mellaart, "Excavations at Çatal Hüyük, 1963, Third Preliminary Report," *Anatolian Studies* 14 (1964): 55 and pl. V. Photograph by James Mellaart, reproduced with permission.

PLATE 1b Redrawing of the entire representation, after the copy by Grace Huxtable. Previously published in J. B. Harley and David Woodward, eds., *The History of Cartography*, vol. 1, *Cartography in Prehistoric, Ancient, and Medieval Europe and the Mediterranean* (Chicago: University of Chicago Press, 1987), 74, fig. 4.19.



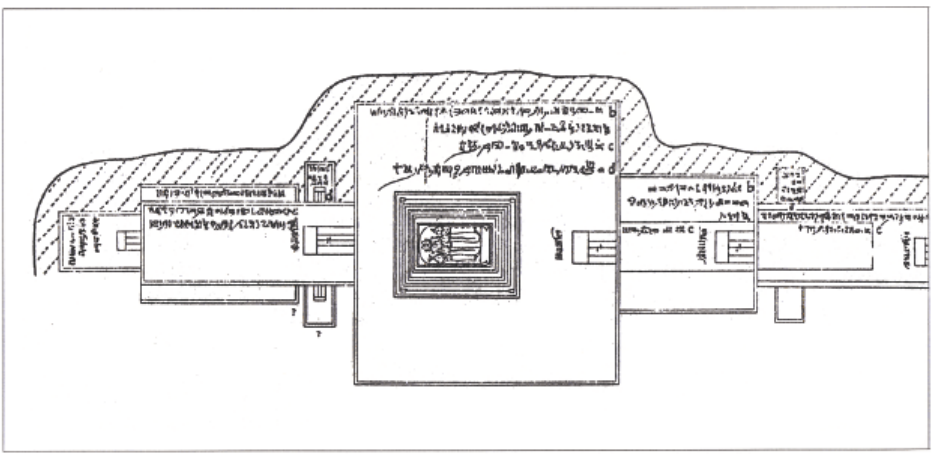


PLATE 2 Detail, papyrus with the plan of the tomb of Ramesses IV, Twentieth Dynasty. Museo Egizio, Turin, Italy. Photo credit: Scala/Art Resource, NY.

PLATE 3 Map of the gold mines. Papyrus fragment, Twentieth Dynasty. Museo Egizio, Turin, Italy. Photo credit: Erich Lessing/Art Resource, NY.

PLATE 4 The world map (incorporating some revisions in northwestern Europe), drawn

according to Ptolemy's second method, from Claudius Ptolemy, *Cosmographia*, based on a manuscript edited and with maps by Donnus (Dominus) Nicolaus Germanus (Ulm: Johann Reger, 1486). The Newberry Library, Gift of Edward E. Ayer. Reproduced with permission.

PLATE 5 Pont du Gard. Roman aqueduct (UNESCO World Heritage Site, 1985) on Gardon River. Photo: S. Vannini. Pont du Gard, Nîmes, France. © DeA Picture Library/ Art Resource, NY.

PLATE 6 Peutinger map: furthest left of the eleven surviving parchments. Southeastern England appears top left. Southwestern France appears immediately below it, and then further below (extending across the entire segment) the narrow channel for the Mediterranean Sea. ÖNB/Wien, Cod. 324, segm. 1. Reproduced with permission.

PLATE 7 The city of Rome and routes fanning out from it on the Peutinger map. ÖNB/Wien, Cod. 324, segm. 4 + 5. Reproduced with permission.

PLATE 8 Imperial orbs excavated in Rome and associated with the self-proclaimed tetrarch Maxentius. Photograph by Clementina Panella, reproduced with permission.

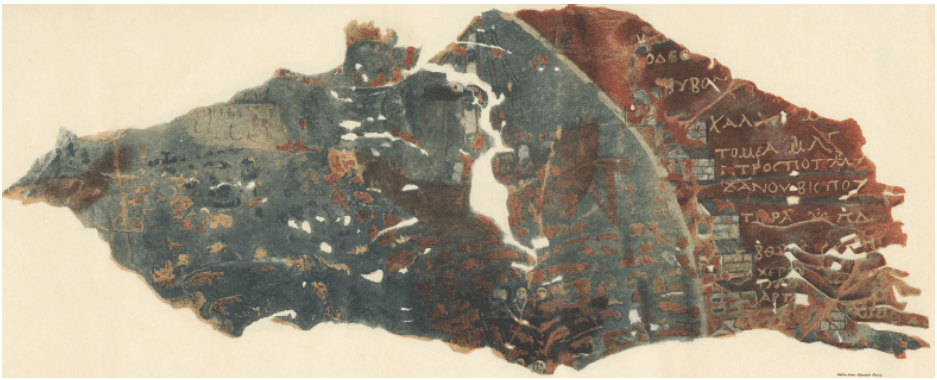


PLATE 9 The Dura parchment (Paris, Bibliothèque Nationale de France ms. Supplément grec 1354[2], V). Insert illustration bound with F. Cumont, “Fragment de bouclier portant une liste d’étapes,” *Syria* 6, no. 1 (1925): 1–15.